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Netizens and WSIS: Celebrating the Demand for Universal Access

In the early 1990s, Michael Hauben and Ronda Hauben began to document the history and social impact of Usenet and the Internet. In 1994, they put their research online as the netizens netbook. Its title was "Netizens and the Wonderful World of the Net." Then, in May 1997 there appeared a print edition, *Netizens: On the History and Impact of Usenet and the Internet,*[1] which is celebrating its tenth anniversary in 2007.

Michael Hauben opens Chapter One of the book *Netizens* with the greeting:

> Welcome to the 21st Century. You are a Netizen (a Net Citizen), and you exist as a citizen of the world thanks to the global connectivity that the Net makes possible. You consider everyone as your compatriot. You physically live in one country but you are in contact with much of the world via the global computer network. Virtually you live next door to every other single Netizen in the world. Geographical separation is replaced by existence in the same virtual space.

True to this prediction, as the 21st Century began, the Internet spread far and wide. Its promise attracted attention. People on every continent wanted access. In 1998, at the International Telecommunications Union (ITU) Plenipotentiary Conference, Tunisia suggested the idea of a World Summit on the Information Society (WSIS). In 2002, recognizing the challenge to make access to the information society and the Internet universal, the United Nations General Assembly endorsed a proposal to hold such a summit. There were to be two phases, the first in Geneva in 2003 and the second in Tunis in 2005. The papers gathered in this issue of the *Amateur Computerist* were presented as a panel in the scientific side event conference, the Past, Present, and Future of Research in the Information Society (PPF),[2] held in conjunction with the Tunis phase of the WSIS.

The WSIS events with their culminating meeting in Tunis in Nov 2005 demonstrated the grassroots desire for the promise of the Internet and of the netizen to be realized around the globe.

In Geneva in Dec 2003, the gathered attendees from 175 countries heard a cry from the people of the world delivered especially by representatives from Africa, Asia and Latin America for inclusion in the Internet age. That was the message from the many heads of state who asked for help to include their people and economies and who feared the result if large numbers of people were left out. The session concluded with a "Declaration of Principles."[3]

Besides a call for the governments of the developed countries and the corporations to help the developing world meet this goal, there was also the recognition that the Internet was an international, public resource that needed proper protection and governance. In a section with a different purpose, the Geneva Declaration addressed who should participate in the governance of the Internet.[4]

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In Nov 2005, the second phase of the WSIS was held. Almost 20,000 participants from more than 175 countries gathered in Tunis. Strong statements of the public nature and need for universal access were heard from many of the heads of state who addressed the Summit. They demanded universal inclusion of all people.

The debate over how the Internet would be managed continued as part of these UN sponsored events. The U.S. maintained its position that governance over domain names, domain name servers and protocol numbers should remain with the so called private sector organization, the Internet Corporation for Assigned Names and Numbers (ICANN) under U.S. government control. Also, there was a debate whether there should be a continuation of the work of the Summit after the Tunis phase came to a close. The forces for multinational or international governance were not able to overcome the U.S. dominance, but they did achieve the plan for an international Internet Governance Forum which met for the first time in Athens in fall 2006 and is planning a second meeting in Rio de Janeiro for fall 2007.

The panel of one of the official side conferences in Tunis whose papers are in this issue provided a glimpse of the pioneering spirit and actions which gave birth to the Internet. Ronda Hauben gave the first presentation, "The International and Scientific Origins of the Internet and the Emergence of the Netizens".

In her presentation, Hauben documented that Internet technology originated from scientific and academic work not from a military oriented project even though its funding came through the U.S. Department of Defense. She argued that the origin of the Internet was in the international collaboration which developed the TCP/IP protocol suite.

Hauben described the vision inspiring the creation and development of the Internet to support collaborative scientific modeling, as a medium that "can be contributed to and experimented with by all." In the longer paper in this issue, she describes some of the controversies in Internet history, explains the nature of the scientific research, and documents the online research by Michael Hauben which led him to discover the emergence of the netizen (net.citizen) with the development of the Internet.

The second presentation, "Vannevar Bush and JCR Licklider: Libraries of the Future 1945-1965" by Jay Hauben countered the myth that the Internet today is different from how it was originally envisioned by the pioneers. The vision is traced partially to the work of Vannevar Bush after WWII but mostly to the thinking and writing and experimenting of JCR Licklider in the 1960s. Bush and Licklider both asked the same question, how could the vast accumulation of knowledge be made useful and be contributed to by all? They both looked to the human brain as a model and to technology for the means to achieve this. The early vision is in many ways being realized. Still to be answered is the question "Will 'to be online' be a privilege or a right?"[5] And there is still the challenge to make the whole corpus of human knowledge available for use by all with semantic in addition to syntactic searching.

Kilnam Chon, in "A Brief History of the Internet in Korea" documented TCP/IP networking developments in South Korea as early as 1982. His story, little told until now, of the development of internetworking in Asia helps dispel the myth that the Internet is an unintended by-product of U.S. military research. In 1985, Korean academic researchers sponsored one of the first international Internet conferences. This was the Pacific Computer Communications Symposium (PCCS) held in Seoul with over 300 attendees from Asia, Europe and North America. The current deep penetration of the Internet into Korean society and the role played there by netizens was put, by Chon, into this long historical context.

Werner Zorn told the story of the coming to the Peoples Republic of China of international email connectivity ("How China was Connected to the International Computer Networks"). German-Chinese friendship formed when the World Bank sponsored the import of West German made Siemens computers for use by Chinese students and academics. This led to collaborative work from 1983 to 1987 which made possible the sending of the first email message from China into the international CSNET email system on September 20, 1987. Zorn documented this story with original email messages and photos. The story contradicted how this history had been told on many websites in China like that of the China Internet Network Information Center (CNNIC)[6] where the role of German scientists and of Professor Wang Yuen Fung was down played in favor of a Chinese engineer who was not involved this early work.

Attending the panel in Tunis was Qiheng Hu, chairperson of the Internet Society in China. After hearing the presentation and seeing some of the documents she said she would have the question investigated. As of May 2007, a corrected version began to appear on the CNNIC website of this history agreeing with what Zorn had presented.[7]

At the Tunis summit, the effort to change from a U.S. government controlled ICANN to an international governance structure for the Internet did not succeed in its main goal. But reasons for that goal were presented on the panel by Anders Ekeland in his presentation, "Netizens and Protecting the Public Interest in the Development and Management of the Internet: An Economists Perspective." Based on the Internet's most important aspect, which Ekeland argued is the free exchange of information and opinion, the Internet is a common good and a public good. That understanding is often hidden because the prevailing economic theory, free market economics, only recognizes private goods. Free market economics is also inappropriate for the analysis of the Internet argued Ekeland because that theory assumes a "general equilibrium" while the Internet is dynamic and ever changing and growing.

Ekeland explained why in market economics there is no role for government or institutions. In such a theory, regulation stems only in cases of "market failure". In the case of the Internet, which is certainly not a failure, international regulation is necessary because there are people in many countries who legitimately need the Internet but have little or no money. Ekeland concluded that a world wide democratic process is better suited than markets to create a rational system for domain name decisions.

The panel was well received, leading to a lively discussion. In summing up the whole PPF conference, one of its organizers, Wiebe Bijker stressed that "science, technology and research played a crucial role in the origin of the Internet." The myth of development for military purposes was dispelled by historical research which showed the many research actors designed it for sophisticated users. Free markets were not the "save-all recipe." These were main themes of the panel whose papers follow and also of the book *Netizens*. In honor of the tenth anniversary of the appearance of the print edition of *Netizens*, it is appropriate that the papers from the panel at the PPF conference be collected and made available in this special issue of the *Amateur Computerist*.

Notes

1) *Netizens: On the History and Impact of Usenet and the Internet*, Los Alamitos, CA, IEEE Computer Society Press, 1997 now distributed by John Wiley and Sons. (Online version at: http://www.columbia.edu/~hauben/netbook/)
2) See the conference website online at: http://www.worldsci.net/tunis/. All the abstracts from the PPF conference have been gathered in a book, *Past, Present, and Future of Research in the Information Society*, edited by Wesley Shrum, Keith Benson, Wiebe Bijker and Klaus Brunnstein, Springer, New York, 2007.
3) Online at: http://www.itu.int/wsis/docs/geneva/official/dop.html. One principle set as the goal "to build a people-centred, inclusive and development-oriented Information Society, where everyone can create, access, utilize and share information and knowledge, enabling individuals, communities and peoples to achieve their full potential in promoting their sustainable development and improving their quality of life…."
4) One of the principles to guide decision making is: "Governments, as well as private sector, civil society and the United Nations and other international organizations have an important role and responsibility in the development of the Information Society and, as appropriate, in decision-making processes. Building a people-centred Information Society is a joint effort which requires cooperation and partnership among all stakeholders."
5) JCR Licklider and Robert Taylor, "The Computer as a Commucation Device" on 1968, online at: http://gatekeeper.dec.com/pub/DEC/SRC/publications/taylor/licklider-taylor.pdf
6) http://www.cnnic.net.cn/en/index/
7) See for example: http://cnnic.net.cn/html/Dir/2003/12/12/2000.htm, where it now reads: "1. In September 1987, with the support from a scientific research group led by Professor Werner Zorn of Karlsruhe University in Germany, a working group led by Professor Wang Yunfeng and Doctor Li Chengjiong built up an Email node in ICA, and successfully sent out an Email to Germany on Sep 20th. The Email title was 'Across the Great Wall we can reach every corner in the world.'"

The International and Scientific Origins of the Internet and the Emergence of the Netizens

by Ronda Hauben
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> Netizens are Net Citizens …. These people … makes [the Net] a resource of human beings. These Netizens participate to help make the Net both an intellectual and a social resource.
> Michael Hauben,
> "Further Thoughts about Netizens"

> Forms grow out of principles and operate to continue the principles they grow from.
> Thomas Paine, "The Rights of Man"

I. Controversies over the Origins of the Internet

There is a controversy about the Internet and its origins that is widespread. This is connected to the misconception that the Internet is the result of the desire of the U.S. department of defense to create a network that would survive a nuclear war.[1] A significant aspect of the controversy is over the origin of the idea of packet switching for the building of the ARPANET. Many credit Paul Baran, a researcher at Rand Corporation.[2]

Larry Roberts, who headed the research project to create the ARPANET as the head of the Information Processing Techniques Office (IPTO) in 1967-1972, explains that Donald Davies, a researcher at the National Physical Laboratory (NPL) in the UK, did significant work in the early development of packet switching, while Paul Baran's work came to be known as the project developed. Describing some of the relevant events, Roberts writes:[3]

> (I)n 1965, a … meeting took place at MIT. Donald Davies, from the National Physical Laboratory in the UK was at MIT to give a seminar on time-sharing. Licklider, Davies and I discussed networking and the inadequacy of data communication facilities for both time-sharing and networking. Davies reports that shortly after this meeting he was struck with the concept that a store and forward system for very short messages (now called packet switching) was the ideal communication system for interactive systems.

Davies subsequently invited IPTO researchers to come to Great Britain to present the research they were doing on time-sharing. In November 1965, ten U.S. researchers gave a set of presentations in Great Britain at a meeting sponsored by the British Computer Society. Describing these presentations, Davies "reports that though most of the discussions were about operating systems aspects of time-sharing, the research done to show the mismatch between time-sharing and the telephone network was described."[4]

Davies writes:[5]

> It was that which sort of triggered off my thoughts and it was in the evenings during that meeting that I first began to think about packet switching.

"The basic ideas," Davies continues, "were produced really just in a few evenings of thought, during or after the seminar." Roberts describes how Davies "wrote about his ideas in a document entitled 'Proposal for Development of a National Communication Service for On-Line Data processing' which envisioned a communication network using trunk lines from 100K bits/sec in speed to 1.5 megabits/sec (T1), message sizes of 128 bytes and a switch which could handle up to 10,000 messages/sec." (Historical note by Roberts: this took 20 years to accomplish). Then in June 1966, Davies wrote a second internal paper, 'Proposal for a Digital Communication Network' in which he coined the word "packet," – a small sub-part of the message the user wants to send, and also introduced the concept of an 'interface computer' to sit between the user's equipment and the packet network. His design also included the concept of a Packet Assembler and Disassembler (PAD) to interface character terminals, today a common element of most packet networks.

It was only after Davies did this pioneering work developing the concept of packet switching that he learned of related work previously done by Baran. "As a result of distributing his 1965 paper," Roberts reports, "Donald Davies was given a copy of an internal Rand report 'On Distributed Communications,' by Baran, which had been written in

August 1964. Baran's historical paper also described a short message switching network using T1 trunks and a 128-byte message size …." Roberts states the influence of Baran's work was "mainly supportive, not sparking its development."

Along with the controversy over the invention of packet switching, there is a related controversy, as to what is the defining nature of the Internet.[6] Is the creation of packet switching and the development of the ARPANET the actual beginning of the Internet, or is the defining characteristic of the Internet something different? I want to propose that the defining characteristic of the Internet is not packet switching, but the design and development of the protocol that makes it possible to interconnect dissimilar computer networks. A protocol in computer networking vocabulary is a set of agreements to make communication possible among entities that are different, as, for example, entities who speak different languages.[7] TCP/IP is a protocol that makes it possible to interconnect dissimilar computer networks.

Robert Kahn, one of the co-inventors of the TCP/IP protocol, explains that the ARPANET was "a single network that linked heterogeneous computer systems into a resource sharing network, first within the U.S., and eventually it had tentacles to computer systems in other countries. What the ARPANET didn't address," Kahn clarifies, "was the issue of interconnecting multiple networks and all the attendant issues that raised." (Kahn, E-mail, September 15, 2002)

To understand the nature of the Internet, it is necessary to understand what could be called the Multiple Network Problem and how it was solved. The difficulties were not only technical.[8]

II. The Internet as the Network of Networks

By 1973 there were various packet switching computer networks either being developed or in the planning stages in countries around the world. To illustrate, there is a memo which shows three of the early packet switching research networks. The memo is from a U.S. researcher. It is dated 1973. It shows three different packet switching networks being developed in 1973.[9] They were:

ARPANET - USA

NPL - UK

CYCLADES - France

Each of these networks was under the ownership and control of different political and administrative entities.

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     (   )                  ( )                     ( )
   (       )               (   )                   (   )
  (          )            (     )                 (     )
( CYCLADES )-(gateway)-( ARPA )-(gateway)-( NPL )
  (          )            (     )                 (     )
   (       )               (   )                   (   )
     (   )                  ( )                     ( )
       /                     \
      /                       \
     /                         \
  (Host)                     (Host)
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Consequently, each of these networks would differ technically in order to meet the needs of the organization or administration that controlled it. The question being raised in this period of the early 1970s is how to interconnect dissimilar packet switching networks.

Considering how to solve the Multiple Network Problem, Davies presented a paper in 1974 on "The Future of Computer Networks." In the paper, he writes:

> To achieve … the interconnection of packet switching systems … a group including ARPA, NPL, and CYCLADES is trying out a scheme of interconnection based on a packet transport network with an agreed protocol for message transport …. (Davies, "The Future of Computer Networks," *IIASA Conference on Computer Communications Networks*, October 21-25, 1974, page 36)

Davies was explaining the research effort to make communication possible among these diverse networks. The conference where Davies presented this paper was held at a detente era research institution. It was called the International Institute for Applied Systems Analysis or IIASA. IIASA was situated in Laxenburg, Austria.

In October 2001, I attended a conference in Berlin where I was fortunate to meet Klaus Fuchs-Kittowski. He was one of the researchers who participated in IIASA in the early 1970s. Fuchs-Kittowski was then a Professor at Humboldt University in the then German Democratic Republic (G.D.R.). When I met Fuchs-Kittowski in 2001, he brought me a copy of a publication put out by the IIASA. It is the proceedings of a workshop held in 1975. He had presented one of the papers at the "Workshop on Data Communications," held on September 15-19, 1975. Others at the workshop included researchers from Austria, Belgium, France, the Federal Republic of Germany, and the German Democratic Republic.

In this 1975 workshop proceedings, was an article by British researchers describing the early development of a British, Norwegian, U.S. research collaboration to make it possible to have the Internet. A diagram, created just one year after the Davies paper considering how to interconnect CYCLADES, NPL, and the ARPANET, shows something quite differently.[10]

The graphic shows international collaboration to create an implementation of the TCP/IP protocol. Involved in this research, however, were Norwegian researchers at NORSAR in Norway, British researchers at the University College of London, in the UK, and American researchers developing the ARPANET.

UCL
NORSAR
ARPANET

The collaborative research on the development of the TCP/IP protocol done by researchers from the UK, U.S. and Norway later included research developing a satellite packet switching network called SATNET. Also, involved in this networking research for shorter periods of time were German and Italian researchers.

There is an interesting graphic of SATNET.[11] In it you can see the German, Italian, U.S., UK, and Norwegian sites. There was also collaborative research creating a packet radio network.

The reason I refer to this history is that it was an international collaboration of researchers working on developing network technology and more particularly in developing the protocol that would make the Internet a reality.

A key to understanding the Internet and its origins, however, is that there is a vision that inspired and provided the glue for such international collaborative research efforts. To explore the nature and origin of this vision helps to understand the research processes creating the TCP/IP protocol and the Internet's subsequent development.

Through studies of the history of the Internet, there is much evidence that the vision for its development had been pioneered by JCR Licklider, an experimental psychologist interested in human communication. Licklider introduced this vision when he gave talks for the ARPA program inspiring people with the idea of the importance of a new form of computing and of the potential for a network that would make it possible to communicate utilizing computers.

III. The Historical Origins of the Vision for the Net and of the Science Guiding the Development

Describing the dynamic nature of communication, Licklider in a paper written with Robert Taylor explains:

> We believe that communicators have to do something nontrivial with the information they send and receive. And … to interact with the richness of living information – not merely in the passive way that we have become accustomed to using books and libraries, but as active participants in an ongoing process, bringing something to it through our interaction with it, and not simply receiving from it by our connection to it …. We want to emphasize something beyond its one-way transfer: the increasing significance of the part that transcends 'now we both know a fact that only one of us knew before.' When minds interact, new ideas emerge. We want to talk about the creative aspect of communication. (Quoted from The Computer as a Communication Device, in *Netizens*, page 5.)

To understand the influences on Licklider and his insight into the dynamic nature of communication, it is helpful to look at the scientific research community he was part of in the late 1940s and early 1950s.

In the early post World War II period, there was much interest in the research and advances in the science of communication and in what was referred to as self-organizing systems. Among those with such interest were Julian Bigelow, an engineer interested in communication technologies, Norbert Wiener, a mathematician interested in the development of automatic systems and about how learning about the functions of the nervous system would provide insight into the creation of such machine systems, Arturo Rosenblueth a researcher and medical doctor who worked with Wiener on similar developments, anthropologists Margaret Mead and Gregory Bateson who studied the social systems of primitive people, and Karl Deutsch who was interested in how looking at political systems through a communication framework would help to understand the nature of such systems.

When considering questions related to communication, the idea of an interdisciplinary research group was considered to be desirable. That is why in the late 1940s and early 1950s there were a number of meetings of an interdisciplinary research group sponsored by a medical foundation, the Josiah Macy Jr. Foundation. This foundation was headed by Frank Fremont-Smith. This group, one of the interdisciplinary research groups established by the Macy Foundation, was to study feedback systems, systems which modified their behavior based on the information gained from previous behavior.

Among the names for such systems were 'self-organizing systems', 'cybernetic systems', 'feedback systems,' 'purposive systems.' A group of 20 researchers from different fields formed the core of the set of scholars who would meet two times a year and discuss their research, hoping that the content and process of their interdisciplinary work would provide stimulating ideas to each other.

JCR Licklider was invited to attend one session of this interdisciplinary research group, in 1950, and to present a paper on his research. (See "The manner in which and extent to which speech can be distorted and remain intelligible." In H. Von Foerster, (Ed), *Cybernetics - circular, causal and feedback mechanisms in biological and social systems. Transactions of the seventh conference*. New York: Josiah Macy, Jr. Foundation.)

Thus Licklider had first hand knowledge of the methodology and practice of the Macy Foundation group, which was to prove helpful to him in a meeting he set up in 1954 and subsequently in his role as the head of the computer research organization he created in 1962 at ARPA, the Information Processing Techniques Office. The processes of the Macy-sponsored meetings were unusual, at least by the standards of present conferences 50 years later, so I want to briefly explain the process and rationale of the conferences.

The conference meeting would take place over a weekend, and there would be two or three papers presented. Participants in the conference were urged to ask questions of the researchers presenting papers, if there were points they didn't understand, during the course of the presentations. Afterwards there would be a more general discussion, and a tape recording would be made of the discussion which would be published as the proceedings of the meeting.

The goal of this process was to encourage the participants to think and explore areas that were new to them, to think over what was being presented and to have a discussion on the presentation. The discussion process was considered as important as the paper presentation. The process of the meetings was intended to help to do research in how to encourage communication across the boundaries of the different disciplines and different methodologies used by these different disciplines.

The last of the ten Macy Foundation Conferences was held in 1953. Licklider and others received support from the National Science Foundation (NSF) in the U.S. to fund a similar interdisciplinary conference at MIT in November 1954.

Licklider and the others who organized the 1954 conference invited researchers in various scientific and technical fields. The topics for the conference were information theory, control theory and communication theory. Several of the researchers made presentations on their recent research, rather than limiting the discussion to only two papers. But discussion among the participants was encouraged. The proceedings were tape recorded and a transcript published in a bound volume by the NSF. (*Problems in Human Communication and Control*; MIT Press, Cambridge, MA, 1954)

IV. The Science of Information Processing

Licklider had begun his scientific career not as a computer scientist but as a psychologist. He finished his PhD thesis in 1942 before the working computer was a reality. The subject of his thesis was path-breaking in its time as he devised and carried out an experiment to "place" the "frequency of neural impulse theories" so as "to understand the perception of pitch and loudness." His particular experiment was to measure the loci of cortical electro-neural activity in the brain of cats to understand their response to hearing different tones of sound.

After receiving his PhD from the University of Rochester, Licklider got an appointment at Harvard University as a research associate and an appointment in the Psycho-Acoustic Laboratory there. This was during WWII and one of the projects the laboratory was investigating was how to enhance radio communication for aircraft to overcome the influence from signal distortion and other noise.

Other research work Licklider did include his creation of clipped speech. He explained how one could alter speech using electronic equipment. He discovered that the information necessary to understand speech could be obtained from focusing on the zero crossings of the speech wave form (where it switches from negative to positive or positive to negative values). This made it possible to create equipment alterations to improve the audibility of speech for pilots.

When the war ended, Licklider became interested in weekly gatherings held by Norbert Wiener to discuss Wiener's concept of cybernetics, of control and communication in biological and machine systems. An interdisciplinary community of researchers developed of which Licklider became part. The notion that one could learn about information processing by studying how it would be carried out in living or machine systems was a source of inspiration to researchers like Licklider and others in this interdisciplinary community.

In the process of his studies of the brain and the nervous system, Licklider became eager to realize the promise of the significant tools that the development of the computer was bringing into existence. An example of such a tool was Sketchpad created by Ivan Sutherland for the TX-2 at Lincoln Labs. In a demonstration that Sutherland gave of Sketchpad, a Project MAC graduate student, Warren Teitelman reports:[12]

> In one impressive demonstration, Dr. Sutherland sketched the girder of a bridge, and indicated the points at which members were connected together by rivets. He then drew a support at each end of the girder and a load at its center. The sketch of the girder then sagged under the load, and a number appeared on each member indicating the amount of tension or compression to which the member was being subjected.

Sutherland was able to use the modeling program he had created to add to the support the computer simulation showed was needed. Then the bridge was, according to the computer program, able to maintain its shape. This is the kind of potential that Licklider envisioned for the research community if they could acquire adequate modeling programs. They would be able to rely on the computer to process data and to demonstrate how the change in one parameter would affect changes in others. But to make such a potential advance possible, a new form of computing would first be necessary. This would be interactive online computing. Licklider not only had a vision for how scientists might find significant support for their research in partnership with computers, he also had an understanding of the kinds of research that would be needed to achieve the technical goals he had identified as desirable.

Along with Licklider's interest to create a computer modeling tool for researchers, he had another objective which was to prove even more inspiring. He recognized the need for a community of researchers to work together if they were to make progress in the hard challenges they faced. He also envisioned how the computer would help to facilitate such collaborative activity. Licklider describes this goal in a memo written in 1963 encouraging the researchers being supported by the Information Processing Techniques Office (IPTO) at centers of excellence around the U.S. to collaborate with each other. He describes how he hopes the researchers working on diverse research will benefit from determining how they can work together. This early support for "Members and Affiliates of the Intergalactic Computer Network" demonstrates the inspiration and conceptual foundation for creating first the ARPANET and then the Internet.[13]

In the memo, Licklider wrote:

> But I do think that we should see the main parts of several projected efforts, all on one

> blackboard, so that it will be more evident than it would otherwise be, where network-wide convention would be helpful and where individual concessions to group advantage would be most important.

Licklider's interest in explaining how computer modeling would serve researchers helped in another important way. It helped to set the foundation for the ARPANET. A graduate student at one of the centers of excellence that Licklider set up, at Project MAC at MIT, Warren Teitelman, wrote his thesis on creating a computer programming language that would encourage interactivity between the scientist and the programmer. His thesis was titled "Pilot: A Step Toward Man-Computer Symbiosis." In his thesis Teitelman set out to contribute to solving the problem of using computers more effectively for solving very hard problems. The kinds of problems he was concerned with were those which "are extremely difficult to think through in advance, that is, away from the computer. In some cases, the programmer cannot foresee the implications of certain decisions he must make in the design of the program."[14] He wrote:

> In such a situation the means of making programs often involved a trial and error process 'write some code, run the program, make some changes, write some more code, run program again'.

Thus there was a need to be able to have the person designing the program continually interact with the computer to make the needed changes.

Licklider believed that thinking is intimately bound up with modeling, and that the human mind is an unmatched and superb environment for demonstrating the power and dynamism of modeling. Licklider and Taylor write:[15]

> By far the most numerous, most sophisticated and most important models are those that reside in men's minds. In richness, plasticity, facility and economy, the mental model has no peer, but in other respects it has shortcomings. It will not stand still for careful study. It cannot be made to repeat a run. No one knows just how it works. It serves its owner's hopes more faithfully than it serves reason. It has access only to the information stored in one man's head. It can be observed and manipulated only by one person.

As Licklider and Taylor note, however, "society rightly distrusts the modeling done by a single mind." Thus, there is a need to transform the individual modeling process into a collaborative modeling process. Licklider and Taylor explain, "society demands … [what] amounts to the requirement that individual models be compared and brought into some degree of accord. The requirement for communicating which we now define concisely 'cooperative' modeling – cooperation in the construction, maintenance and use of a model."[16]

To make cooperative modeling possible, Licklider and Taylor propose that there is the need for "a plastic or moldable medium that can be modeled, a dynamic medium in which processes will flow into consequences …." But most important, they emphasize the need for a common medium "that can be contributed to and experimented with by all."

> The prospect is that, when several or many people work together within the context of an on-line interactive, community computer network, the superior facilities of the network for expressing ideas, preserving facts, modeling processes, and bringing two or more people together in close interaction with the same information and the same behavior – those superior facilities will so foster the growth and integration of knowledge that the incidence of major achievements will be markedly increased.[17]

At the foundation of this relationship between the human and the computer that Licklider recognized as so important is his understanding of the importance of combining the heuristic capability of the human with the algorithmic capability of the computer. Heuristic activity, according to Licklider, is "that which tends toward or facilitates invention or discoveries, that charts courses, formulates problems, guides solutions. The heuristic part is the creative part of information power."[18]

For Licklider, the goal of the research he was doing was to help catalyze the development of a new science, a science of information processing in biological and machine systems. A helpful definition of information science was created by the Committee on Information Sciences for the University of Chicago program established in 1965.

They explained:[19]

> The information sciences deal with the body of knowledge that relates to the structure, origination, transmission and transformation of information in both naturally existing and artificial systems. This includes the investigation of information representation, as in the genetic code or in codes for efficient message transmission, and the study of information processing devices and techniques, such as computers and their programming systems.

This new science included biological and machine systems as part of its scientific study. Licklider was hopeful that the computer would "help us understand the structure of ideas, the nature of intellectual processes."

"Although one cannot see clearly and deeply into this region of the future from the present point of view," Licklider believed, "he can be convinced that information processing," which now connotes to many "a technology devoted to reducing data and increasing costs," will one day be the field of a basic and important science, which will be an in interdisciplinary science.[20]

This new interdisciplinary science, would include, "Planning, management communication, mathematics and logic, and perhaps even psychology and philosophy will draw heavily from and contribute to that science."

"One of the most important present functions," Licklider writes for the "the digital computer in the university should be to catalyze the development of that science." A first step for this new science was to determine what was the most appropriate role of the computer and the human in the relationship between them, and what was the desirable interaction leading to the most advanced mutually beneficial development of each.

Licklider's research into what would be the role of the human and the role of the computer, i.e., a symbiotic relationship, helped to set a foundation for the research program he instituted when he was chosen by ARPA to head the IPTO in 1962.

As computer networking developed and spread, Licklider observed that creative users emerged.[21] Licklider recognized that the creative users developed uses of the network which became catalysts for the development of new and desirable forms and processes that other users would benefit from. Licklider called these creative users 'socio-technical pioneers' and he encouraged the support of their explorations and online activity. Licklider recommended putting off as long as possible the general use of the developing network by other users who would not be exploring its potential. He felt that it was important not to kill the goose who laid the golden eggs of the network and that it was crucial to protect the access of creative users to an exploratory and creative online environment. Licklider defined these 'socio-technical pioneers' as not only the creative users who explored how new online forms and processes could be developed and utilized, but he also recognized the importance of the programmers who were creating the software and the forms of making the software public and something to which many could contribute.

V. The Role of Scientists and Decision Makers in New Technology Decisions

After the Macy conferences and the NSF conference modeled on it, Licklider participated in other similar experiences. Another conference Licklider participated in which has been transcribed into a book version was held at MIT on the occasion of the 100th anniversary of MIT. A series of talks was held and the talks, along with the discussion, were transcribed and published in an edited volume by Martin Greenberger, then a young faculty member at MIT.[22]

While there were a number of talks included in this volume about the vision for the future development of the computer and for the science that would develop alongside the computer development and the science of information processing, the keynote talk was particularly significant. This keynote was by Sir Charles Percy Snow (C.P. Snow), a scientist and civil servant from Great Britain. The topic of Snow's talk was "Scientists and Decision Making."[23]

Snow spoke about the important public policy issues that would accompany the development of new computer technology, and about the difficulty government officials would have determining how to make decisions about the technology which took into account the public interest. In his talk, Snow described why there would be a need for many people to be involved in the decision making process. He proposed the need for broad based public discussion on the issues relating to new computer development. Snow explains:

> I believe that the healthiest decisions of society occur by something more like a Brownian movement. All kinds of people all over the place suddenly get smitten with the same sort of desire, with the same sort of interest, at the same time. This forms concentrations of pressure and of direction. These concentrations of pressure gradually filter their way through to the people whose nominal responsibility it is to put the legislation into a written form.

"I am pretty sure," Snow continues, "that this Brownian movement is probably the most important way in which ordinary social imperatives of society get initiated." (Greenberger, pages 6-7) Snow referred to this broad based public discussion as a political form of the physical phenomenon known as Brownian motion. He proposes that, based on such discussion, better decision making processes would result than if the issues were restricted to secret behind-the-scenes government processes. In his talk, Snow characterizes the limited process of decision-making of government in the U.S.:

> We all know that even in non secret decisions, there is a great deal of intimate closed politics …. In (the U.S.) you elect a President; he initiates legislation (that is, he takes a decision as to which legislation to produce), and then the Congress takes the decision as to whether this legislation is to go into action. (Greenberger, page 6)

Snow explained how government decisions were made in Great Britain, involving a similarly limited number of people as in the U.S. Such a narrow set of people being involved in making decisions was for Snow a sign of a serious problem.

If we follow the explosive development in computer technology that followed C. P. Snow's talk in 1960, we will see that not only was there foresight about the magnitude of change in computer development that would occur in the next 40 years, but also about the technical changes that would result in significant changes in society in general and in the economy in particular. Similarly, the nature of the new technical and scientific developments would require greater social understanding. The social ferment that comes from involving some broader strata of the people in the discussion about the policy issues that are needed to encourage technical development was identified as the process to develop this social understanding.

Shortly after the MIT anniversary programs on the "Future of the Computer," Licklider was invited to create an office for research in computer science and another office for research in behavioral science, within the U.S. Department of Defense (DOD). He formed the Information Processing Techniques Office in ARPA which was under the U.S. Department of Defense. Licklider was not a computer scientist. He was invited to ARPA to focus on the needs of the user and to create a computer that would serve the user.

At ARPA Licklider began a research program that would fundamentally change not only the architecture of computers but the architecture of how computers were used. Not only did the research done under his leadership make a great impact on the type of computing available in the world, but also he identified the need for computer networking and put forward the vision that would inspire computer scientists to develop time-sharing, packet switching and the ARPANET.[24]

Licklider's first term as director of IPTO put the office on a firm foundation that served to fundamentally influence the nature and direction of computer science. He created an intergalactic network of researchers who were supported in their work.

VI. The Politics of Science and Technology

Licklider returned to IPTO in 1974-1975. He found, however, that a significant change had occurred. The kind of basic research he had pioneered was no longer welcome. Instead there was pressure to do research that would meet prescribed outcomes and would be oriented to produce defense specific products.

Licklider challenged these changes both in his second term at IPTO and in talks and articles published after he left. These articles help to provide a guidepost for how the computer and networking development that Licklider envisioned can be practically achieved.[25]

The problem Licklider discovered was the same problem that C. P. Snow had anticipated. The problem was that there were government officials who needed to make decisions about the new technology, but were not able to understand the depth of the issues involved. The difficulty of this problem led Licklider to propose the need to have citizens participate in the process of determining how government would support new technology.

Licklider advocated that the networks themselves be used by those online to influence government policy regarding the continuing development of the networks. Licklider was not proposing that citizens rely on voting as the way to influence government. To the contrary, Licklider writes:

> That does not mean simply that everyone must vote on every question for voting in the absence of understanding defines only the public attitude, not the public interest. It means that many public-spirited individuals must study, model, discuss, analyze, argue, write, criticize, and work out each issue and each problem until they reach a consensus or determine that none can be reached – at which point there may be occasion for voting. (Licklider, 1979, page 126)

Licklider also felt that "many public-spirited individuals must serve government – indeed must be the government." (Licklider, 1979, page 126) This is because, whether or not all citizens would have networking access, was a problem which would require government initiatives to solve. And the active involvement of public-spirited individuals was needed. Licklider saw that people in the U.S. were frustrated with the government. To change this situation, Licklider advocated making it possible for citizens to participate in government decision-making via the developing computer networks. Licklider writes:

> Computer power to the people is essential to the realization of a future in which most citizens are informed about, and interested and involved in, the process of government. (Licklider, 1979, page 124)

Licklider saw the problem that the current "decision makers and opinion leaders see computers in terms of conventional data processing and are not able to envision or assess their many capabilities and applications."

He maintained that not only must the decisions about the development and exploitation of computer networks be made "in the public interest," but also in "the interest of giving the public itself the means to enter into the decision-making processes that will shape their future." (Licklider, 1979, page 126) Here Licklider expresses the goal that citizens communicate with each other and with the officials and designers of a social policy or plan. The importance of such online developments identified in the 1960s and 1970s by Licklider and others, was demonstrated in the 1990s.

VII. The Emergence of the Netizen

In 1992-1993, Michael Hauben, was in his second year as a college student at Columbia University in New York City. Describing the research that he did which revealed the emergence of Netizens, of the online net.citizens that Licklider identified as needed for the continuing development of computer technology, Hauben relates how he first got online in 1985 using what were known as local hobbyist computer bulletin board systems. At the time he was living in Michigan, where research for the development of the Internet was being carried out.[26]

Describing the experience he had online, Hauben writes:

> I started using local bulletin board systems (called BBS's) in Michigan in 1985. After several years of participation on both local hobbyist-run computer bulletin board systems and the global Usenet, I began to research Usenet and the Internet.
>
> This was a new environment for me. Little thoughtful conversation was encouraged in my high school. Since my daily life did not provide places and people to talk with about real issues and real world topics, I wondered why the online experience encouraged such discussion and consideration of others. Where did such a culture spring from? And how did it arise? During my sophomore year of college in 1992, I was curious to explore and better understand this new online world. (*Netizens*, "Preface," page ix[27])

Hauben explains how, "As part of coursework at Columbia University I explored these questions. One professor encouraged me to use

Usenet and the Internet as places to conduct research. My research was real participation in the online community, exploring how and why these communication forums functioned." He continues, "I posted questions on Usenet, mailing lists and Freenets.[28] Along with my questions I would attach some worthwhile preliminary research. People respected my questions and found the preliminary research helpful. The entire process was one of mutual respect and sharing of research and ideas, fostering a sense of community and participation." (*Netizens*, page ix)

Through this research process, he "found that on the Net people willingly help each other and work together to define and address issues important to them." This was the experience people had on Internet mailing lists and Usenet newsgroups in the early 1990s, before the web culture had developed and spread. What one found was a great deal of discussion and interactive communication online. This was like the computer bulletin board culture that flourished in the 1980s and early 1990s. While the computer bulletin boards put users in contact with local computer users, Usenet newsgroups and Internet mailing lists put users in contact with other computer users from around the world. When Hauben posted his early research questions on Usenet and the Internet, he received about 60 responses from around the globe. A number of these responses were detailed descriptions of how people online had found the Net an exciting and important contribution to their lives. Not only did the Internet make a difference in the range of experiences and in contacts people could reach, but also, and sometimes more important, it made possible a more satisfying, broader experience of communication.

Elaborating on the progression of his research, Hauben writes:

> My initial research concerned the origins and development of the global discussion forum Usenet. For my second paper, I wanted to explore the larger Net, what it was, and its significance. This is when my research uncovered the remaining details that helped me recognize the emergence of Netizens. (*Netizens*, page x)

While people answering his questions were describing how the Internet and Usenet were helpful in their lives, many wrote about their efforts to contribute to the Net, and to help spread access to those not yet online. It is this second aspect of the responses that Hauben received which he recognized as an especially significant aspect of his research.

Describing the characteristics of those he came to call Netizens, Hauben writes:

> The world of the Netizen was envisioned more than twenty-five years ago by JCR Licklider. Licklider brought to his leadership of the U.S. Department of Defense's ARPA program a vision of the 'intergalactic computer network'.
>
> There are people online who actively contribute to the development of the Net. These are people who understand the value of collective work and the communal aspects of public communications. These are the people who discuss and debate topics in a constructive manner, who e-mail answers to people and provide help to newcomers, who maintain FAQ's, files and other public information repositories. These are the people who discuss the nature and role of this new communications medium. These are the people who as citizens of the Net I realized were Netizens. (*Netizens*, pages ix-x)

Later Hauben elaborates:

> Net.citizen was used in Usenet … and this really represented what people were telling me – they were really net citizens – which Netizen captures. To be a 'Netizen' is different from being a 'citizen'. This is because to be on the Net is to be part of a global community. To be a citizen restricts someone to a more local or geographical orientation. (From "Webchat with Michael Hauben," Jan. 25, 1996)

Hauben was not referring to all users who get online. He differentiates between Netizens and others online:

> Netizens are not just anyone who comes online. Netizens are especially not people who come online for individual gain or profit. They are not people who come to the Net thinking it is a service. Rather, they are people who understand that it takes effort and action on each and everyone's part to make the Net a regenerative and vibrant community and resource. (*Netizens*, page x)

Several of the articles Hauben wrote about the history and impact of the Net were posted online and then collected into a book. In January 1994 the book was put online at an FTP site documenting the origins of the online network and culture it gave birth to. In his preface to the book Hauben wrote:

> As more and more people join the online community and contribute toward the nurturing of the Net and toward the development of a great shared social wealth, the ideas and values of netizenship spread.

By 1995, Hauben's research was recognized internationally, and he was invited to Japan to speak at a conference about the subject of Netizens. In his talk, he describes his early investigation of Usenet and the Internet and what he learned from his research and experience online. He writes:[29]

> The virtual space created on noncommercial computer networks is accessible universally. This space is accessible from the connections that exist; whereas social networks in the physical world generally are connected only by limited gateways. So the capability of networking on computer nets overcomes limitations inherent in non computer social networks. Access to the Net, however, needs to be universal for the Net to fully utilize the contribution each person can represent. Once access is limited, the Net and those on the Net lose the full advantage the Net can offer. Lastly the people on the Net need to be active in order to bring about the best possible use of the Network.

VIII. The Online Community

It is interesting to see how closely the conceptual vision Hauben developed matched that of the vision of JCR Licklider. Hauben's views were influenced by his experience online, his study and the comments he received in response to his research questions from people around the world.[30] Licklider had recognized the need for an online community that would encourage users to contribute to be able to develop computer and network science and technology. This collaborative environment is what people found online on Usenet and the Internet even into the early 1990s.

Licklider and later Hauben advocated support and protection of the creative users online who were eager to explore how to utilize the Internet in interesting and novel new ways. Both staunchly maintained that users had to be participants in making the decisions that would develop and spread the Internet to all. Both warned that commercial entities could not develop a network that would spread access to all or that would encourage user participation in its development.

The conscious netizen, the net.citizen that Hauben identified online in the 1992-1993 period when he was doing his initial research about the history and social impact of the Internet coincided with Licklider's ideas that there was a need to have creative users online to help the Internet to develop and to care for its continuing development.[31]

The concept and consciousness of oneself as a netizen has since spread around the world. By the mid 1990s, people online had begun to refer to themselves as netizen, in the fashion of how 'citizen' was used during the French Revolution.

There have been significant achievements of netizens in countries around the world. The netizens of South Korea, however, deserve particular mention. They are helping to shape the democratic practices that extend what is understood as democracy and citizenship. Their experience provides an important body of practice to consider when trying to understand what will be the future form of political participation.[32]

IX. Methodology

What are the implications of Licklider's ideas about models and about the brain and modeling, for the study of the Internet and the creation of a research agenda for this study? Recent articles in the "Annals of the History of Computing" and other engineering publications provide a perspective toward what methodology and framework are needed for such study.

One article is an editorial by Hunter Crowther-Heyck titled "Mind and Network."[33] The author proposes that the Internet is attractive as a 'new model.' He recognizes that this is not an accident, but the result of the interest in models and modeling by those in the cybernetic community that Licklider was a member of in the 1940s and 1950s. This community was also interested in how the human mind worked. They wondered what they could learn about the human brain from learning about the computer, and what they could learn about the computer, from learning about the brain.

Licklider and Taylor's article "The Computer as a Communication Device," however, takes this relationship one step further. By focusing on the human-computer system as a network, they are able to consider the implications for the augmentation of the human capability that being part of a collaborative communication network would make possible.

The article, "Engineering Disclosing Models," by the British historian of science, Michael Duffy makes the argument why a new methodology is needed for the history of engineering to support the new advances made possible by information technology.[34] Duffy maintains that modern engineering developments are a change in a conceptual paradigm as fundamental as the change described in the *Elizabethan World Picture*.[35] In his book, Tillyard describes a paradigm change that took place in science in the 16th and 17th centuries. This was a change from the metaphysics that took as its fundamental basis the four elements of fire, air, earth and water, to a science that would focus on the nature of the phenomenon being observed in order to determine the scientific laws and underlying principles.

The changed paradigm led to the discovery of thermodynamics and mechanics and other scientific explanations that made possible the industrial revolution. Duffy proposes that there is a need to create a new conceptual framework by which to understand the history of engineering and by which to help inspire support for its future development.

He explains how the new technologies of our time "are very different from the machines and systems which built and powered the former phases of industrialization, and their raw material is more likely to be a living organization, the nervous system or information …." Because new kinds of industry are being created as consequences of this development, he argues, the new technologies require a conceptual apparatus adequate for interpreting the physical and biological phenomenon.

Duffy is calling for a change from looking at engineering as artifacts as has been common in the past. The "history of technology is too often focused on industrial [artifacts]," he writes. He points out that there is a need for a new history of engineering and a new methodology to develop that history. The history he is proposing is one that will focus on the concepts and models of engineering activities. Duffy defines engineering as, "The science which includes technology." (page 22) He is proposing the need to identify the model that engineers use, the 'conceptual apparatus,' (page 29) that helps to understand a technological process and to explore how to develop it. Duffy argues that there is a need to create "imaginary models or analogies of the phenomenon" being developed. Then "these models can be abstracted, generalized and idealized." (page 27)

"All design," he writes, "must of course be subjected to practical tests." Duffy identifies what he calls "disclosing models," as a means to provide this new conceptual framework to reinterpret and deepen understanding of engineering in the past and to provide a new conceptual apparatus for the future. (pages 22-23, see page 29) "Even the simplest model can effect a revolution," he observes. An example he offers is the advance that came from borrowing the model of the "semipermeable membrane" from chemistry to describe "the actions of the model of the heart by the 'diastolic and systolic action'." (page 28)

X. Research Questions

In his article, "How Did Computing Go Global: the Need for an Answer and a Research Agenda," James W. Cortada raises a series of questions about how computer developments have occurred and spread so rapidly in just the past 50 years. "How this class of technology dispersed so quickly … remains little understood," he observes.[36] Considering "why this is a useful question," he concludes that, "In short this story is too big and too important to ignore." Cortada then asks "what is it critical to examine" and "how to do so." (page 53)

While Cordata is making a set of observations about the rapid spread of computer technology, similar observations about the rapid spread of the Internet could be made which would be even more striking. Cortada proposes that the question of "what to examine" is a question to ask about how to study the rapid development and spread of computer technology, "what to examine" is similarly an important question to help to formulate a research agenda on the history and development of the Internet.[37]

XI Conclusion

This paper began with a reference to the mythology that surrounds the origins and development of the Internet. A problem that results from the widespread dissemination of this mythology is that it stands in the way of the researchers and the public recognizing the significant scientific and social advance represented by the creation and the development of the Internet.

It is not that the Internet has grown and spread as an accidental side effect of some obscure U.S. military project, as the mythology would lead one to believe. To the contrary, the Internet is the result of a significant scientific collaboration among an international group of researchers to solve the problems, technical and political, of making communication possible across technical and political boundaries.

Not only was there international collaboration to create the TCP/IP protocol, but this technical research had a scientific foundation in the ferment among an interdisciplinary community of researchers in the 1940s and 1950s who were interested in the science of information processing, of communication, and of control systems.

Along with the scientific interactions of these researchers, there was a concern about the social problem that the new technology would encounter. A primary concern was how to deal with the problem of government officials who would not understand the depths of the issues involved, but who would have to make decisions about the future of the new technology.

To help solve this problem, Licklider recognized that there was a need for increased citizen participation in the decisions that would be made with respect to the new technology. He also recognized that the new computer networking technology would help to make a new form of participatory citizenship possible.

The creation of mailing lists and online discussion groups like Usenet newsgroups have provided support for grassroots participation in networking development. This in turn has helped to create and define the broad ranging social and technical vision that has helped the online community create and develop a significant new social institution, often referred to as 'the Net'.[38]

Even more profoundly, in the early 1990s, just when a number of networks around the world were becoming part of the Internet, research revealed that a new form of social identity and consciousness had emerged within the online community. The identity of oneself as a 'netizen', i.e., a net.citizen, was embraced as a way to refer to the new social consciousness that participation online made possible.

Reviewing Licklider's interest in the brain and the modeling feature of the brain and his understanding that the individual nature of this modeling was a limitation that needed to be overcome, one is struck by how precious and important is the online collaborative and interactive activity that the Internet makes possible.

While there has been much political and financial attention given to the creation of so called new models for Internet governance, there has been little attention or institutional interest in trying to learn the lessons of how the Internet grew and spread and how the netizen emerged. As Thomas Paine observed, almost three centuries ago, "Forms grow out of principles and operate to continue the principles they grow from." (*The Rights of Man*)

By understanding the principles that made it possible to develop the Internet, it will be possible to understand how to create the forms needed to nourish its continuing development. The Internet and the netizen provide a means to carry on this process. That is why there is a serious need for the formulation of a research agenda to support this much needed study.

Notes:

(1) "Packet Switching," Wikipedia, http://en.wikipedia.org/wiki/Packet_switching

(2) Baran wrote a 11-volume set of booklets "On Distributed Communication" in 1964. Baran's research was sponsored by the U.S. Air Force and proposed a military communication system for voice and data.

(3) Lawrence G. Roberts, "The Evolution of Packet Switching" http://www.packet.cc/files/ev-packet-sw.html

(4) Ronda Hauben, "The Birth of the Internet: An Architectural Conception for Solving the Multiple Network Problem" http://umcc.ais.org/~ronda/new.papers/birth_internet.txt

(5) "An Interview with Donald W. Davies," conducted by Martin Campbell-Kelly, on 17 March 1986 National Physical Laboratory, "Actually, most of the discussions tended to be about the operating system aspects, but certainly the mismatch between time-sharing and the telephone network was mentioned. It was that which sort of triggered off my thoughts, and it was in the evenings during that meeting that I first began to think about packet-switching." (page 6) See also Thomas Marill and Lawrence G. Roberts, "Toward a Cooperative Network of Time-Shared Computers," *Proceedings-Fall Joint Computer Conference, AFIPS 29,* 425-431, Washington, D.C., Spartan Books, 1966, and Interview with Davies.

(6) Ronda Hauben, "A Closer Look at the Controversy Over the Internet's Birthday!," *CircleID*, January 15, 2003. http://www.CircleID.com/posts/a_closer_look_at_the_controversy_over_the_internets_birthday_you_decide

(7) These networks can differ significantly. To transport packets among dissimilar networks meant a whole set of issues had to be understood and resolved, according to Robert Kahn, one of the co-inventors of the TCP/IP protocol. Among the issues listed are: packets on different networks would be of different sizes, there would be different decisions made regarding timing, flow control, error checking and so forth. There would need to be a means of having all the different networks recognize how to route packets to their destination address. A form of addressing was needed which would be recognized by all the networks of the Internet.

(8) See Ronda Hauben, "The Internet: On its International Origins and Collaborative Vision (A Work in Progress)" http://umcc.ais.org/~ronda/new.papers/birth_tcp.txt

(9) Vinton Cerf. See: http://umcc.ais.org/~ronda/new.papers/1.pdf

(10) Sylvia B. Kenney and Peter Kirstein, "The Uses of the ARPA Network via the University College London Node," *Workshop on Data Communications Sep 15-19, 1975, CP-76-9*, IIASA Laxenburg, Austria, 1975, page 54, http://www.ais.org/~ronda/new.papers/2.pdf

(11) See graphic of SATNET at: http://umcc.ais.org/~ronda/new.papers/4.pdf from an E-mail between the author and Horst Claussen and Hans Dodel.

(12) Warren Teitelman, "Pilot: A Step Toward Man-Computer Symbiosis," September 1966, Project MAC, MIT, MAC-TR-32 (Thesis), page 11.

(13) JCR Licklider, "MEMORANDUM FOR: Members and Affiliates of the Intergalactic Computer Network, Subject: Topics for Discussion at the Forthcoming Meeting, April 23, 1963," ADVANCED RESEARCH PROJECTS AGENCY Washington 25, D.C. http://www.olografix.org/gubi/estate/libri/wizards/memo.html

(14) *Ibid.*, Teitelman, abstract, p. I.

(15) JCR Licklider and Robert Taylor, "The Computer As a Communication Device," *In Memoriam: JCR Licklider, 1915-1990*, Digital Systems Research Center Palo Alto, CA, 1957, page 21 http://memex.org/licklider.pdf

(16) *Ibid.*

(17) *Ibid.*

(18) "The On-Line Intellectual Transfer System at MIT in 1975." Carl F. J. Overhage and R. Joyce Harman, *The On-Line Intellectual Community and the Information Transfer System at MIT in 1975*, page 25

(19) See for example Licklider, JCR "Computers: Thinking Machines or Thinking Aids?" *Mgmt. Rev. 54* (July 1965) 40-43.

(20) "In order to understand the wonder that the Internet and various other components of the Net represent, we need to understand why the ARPANET Completion Report ends with the suggestion that the ARPANET is fundamentally connected to and born of computer science rather than of the military." Chapter 7, Behind the Net: The Untold Story of the ARPANET and Computer Science, by Michael Hauben, in *Netizens*, page 96. See also "The developers of the ARPANET viewed the computer as a communication device rather than only as an arithmetic device. Such a shift in understanding the role of the computer was fundamental in advancing computer science." *Ibid.*, page 109.

(21) Ronda Hauben, "Computer Science and the Role of Government in Creating the Internet: ARPA/IPTO (1962-1986) Creating the Needed Interface," http://www.columbia.edu/~rh120/other/arpa_ipto.txt

(22) Greenberger, Martin ed, *Computers and the World of the Future,* MIT Press, Cambridge, 1962.

(23) *Ibid*., C. P. Snow, "Scientists and Decision Making," pages 3-13 (Talk given at MIT, March 1961)

(24) Ronda Hauben, "Computer Science and the Role of Government in Creating the Internet," http://ais.org/~ronda/new.papers/arpa_ipto.txt

(25) JCR Licklider, "Computers in Government," in Michael Dertouzos and Joel Moses, *The Computer Age: A Twenty-Year View*, Cambridge, MIT Press, 1979, pages 87 - 126.

(26) This was under a contract between ANS, the Univ of Michigan and IBM

(27) Michael Hauben and Ronda Hauben, *Netizens: On the History and Impact of Usenet and the Internet*, IEEE Computer Society, Los Alamitos, CA, 1997.

(28) In the 1990s, community networks called Freenets were just springing up which provided local users with free access to the Internet.

(29) From "The Netizens and Community Networks," presented at the Hypernetwork '95 Beppu Bay Conference on November 24, 1995 http://www.columbia.edu/~hauben/text/bbc95spch.txt

(30) It is remarkable how the ideas about democracy and communication that Hauben recognized from his research and the ideas that Licklider had about citizens being involved in the decisions that would influence the future of the net coincide with the ideas that Jurgen Habermas had conceptually described as a public sphere. In an article describing Habermas's theory, Mark Warren explains the aspects of discursive democracy that Habermas has identified. The importance of Habermas's work is that he focus on communication and the procreative quality of communication (the transformative quality), in a way that is similar to that of Licklider and Hauben. On the other hand, the difference is that Hauben and Licklider consider the importance of an actual technological support for this human communicative activity, while Habermas speaks more abstractly and focuses on

the human activity in a more philosophical (or normative) framework.

(31) Ronda Hauben, "The Information Processing Techniques Office and the Birth of the Internet: A Study in Governance," http://www.columbia.edu/~rh120/other/misc/lick101.doc

(32) Ronda Hauben, "The Rise of Netizen Democracy: A case study of the impact of netizens on democracy in South Korea," in manuscript.

(33) Hunter Crowther-Heyck, "Mind and Network," Vol. 27, Issue: 3 *IEEE Annals of the History of Computing*, July-Sept. 2005, page 104.

(34) Michael C. Duffy, "Engineering Disclosing Models," *Helvelius Book 2*, edited by Oktawian Nawrot, University of Gdansk, 2004, pages 22-64.

(35) *Ibid.*, page 56.

(36) James W. Cortada, "How Did Computing Go Global? The Need for an Answer and a Research Agenda," *IEEE Annals of the History of Computing,* January 2004, pages 53-58.

(37) In this context I want to point to the Asian networking association online Internet history museum as one project with has been created to document how networking has developed in the countries in Asia. http://www.internethistory.or.kr/

(38) This reflects the fact that the pre-Internet forms like Usenet, BITNet, mailing lists, and a number of other networking developments in the 1970s and 1980s prepared the ground for the Internet which enveloped all these other networks by the mid 1990s.

Appendix

Examples included Steve Alexander who compiled and distributed a list of gas prices at particular gas stations in California to which many people contributed and kept up to date. (He started this in a newsgroup ca.driving). His effort was to work with others to counteract the collusive price-gouging behavior of the oil companies. (page 11 *Netizens*)

Another response was from Declan Mc Creesh who wrote about how the most up-to-date sports information was available online. It had been contributed to by different people about the Grand Prix.

Godfrey Nolan wrote about how a newspaper about Ireland distributed online by Lian Ferrie who worked in Galway helped Godfrey to keep up with what was happening in his home country.

Malcolm Humes wrote how the kind of conversation online was about substantial issues rather than "how's the weather" type of small talk.

There are numerous other descriptions in the paper Hauben wrote which he titled, "The Net and Netizens: the Impact the Net is having on People's Lives."

Hauben's paper is online as chapter 1 of *Netizens: On the History and Impact of Usenet and the Internet* The URL is: http://www.columbia.edu/~hauben/netbook/

Specific examples of netizen activity to help spread the consciousness of the netizen:

A netizen from Ireland, Cal Woods put the online book into html to help it to spread more widely.

A review of the book was done by a Rumanian researcher, Boldur Barbat. He recognized that netizenship is an important new democratic development and acts as a catalyst for the development of ever more advanced Information Technology.

In his review of *Netizens*, the Rumanian researcher summed up Chapter 13, the chapter about the effect of the Net on the news media. He wrote: "Chapter 13 investigates the effect of the Net on the professional news media, under the metaphor of 'Will this kill that?'; its conclusion is rather optimistic: the user masses becoming 'netizen reporters' will force the acknowledged news media – to avoid being increasingly marginalized – to evolve a new role, challenging the premise that authoritative professional reporters (almost always biased, consciously or not) are the only possible ones." From Boldur Barbat, "Book Review: Netizens: On the History and Impact of Usenet and the Internet," *Studies in Informatics and Control*, Vol. 7, No 4 (December 1998). www.ici.ro/ici/revista/sic1998_4/art06.html

A Japanese sociologist, Shumpei Kumon, gathered a series of articles into a book in Japanese titled 'The Age of Netizens'. The book begins with a chapter on the birth of the netizen.

Also in the mid 1990s, a Polish researcher, Leszek Jesien, was doing research about what form of citizenship would be appropriate for the European Union (EU). Looking for a model that might be helpful to understand how to develop a European-wide form of citizenship, he found the work about netizens online. He recommended that EU officials would do well to view the phenomenon of netizenship with sympathy and attention as a model of a broader than national, but also a participatory form of citizenship.

The Polish researcher's paper: "The 1996 IGC: European Citizenship Reconsidered," by Leszek Jesien, Instituets fur den Donauraum und Mitteleuropa, March 1997. http://www.columbia.edu/~hauben/netizens/list-archive/Related-Articles/Jesien.rtf See also: http://www.columbia.edu/~rh120/other/misc/citizenpap.html

Notable events showing the impact of netizens around the world include:

A Netizen art contest seeking online art that helps to build the online community was sponsored by a gallery in Rome.

A Netizens Association to keep the price of the Net affordable was organized in Iceland.

A lexicographer in Israel composing a dictionary definition for a Hebrew dictionary wanted to be certain that she described a netizen as one who contributes to the Net, not only as anyone online.

A Congressman in the U.S. introduced a bill into the U.S. House of Representatives called the Netizen Protection Act to penalize anyone who sent spam on the Internet.

Along with individual efforts to develop and spread the consciousness of netizenship, there have been online discussions which have demonstrated the power of the Net and Netizen to impact society. One such example is a discussion about an editorial in an Indian newspaper about whether or not India should help the U.S. to invade Iraq. The discussion had more than a thousand entries.

Vannevar Bush and JCR Licklider: Libraries of the Future 1945-1965[1]

by Jay Hauben
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I. Introduction

The whole human species is engaged in adding experience and knowledge for itself and future generations. A vision of gathering the knowledge already created to make it accessible and useful to all was put forward by JCR Licklider and his Libraries of the Future project in 1961-1963. Licklider and his team built on thinking begun before the Second World War that machines would help with this work. Much of the earlier thinking is associated with Vannevar Bush.

Throughout history, thinkers and scholars have lamented that there is not enough time to read everything of value. The real problem is not the volume of valuable scholarship and recorded thought and reasoning. The historic problem for scientists and scholars has been selecting and gathering the relevant material and processing it in their own brains to yield new knowledge. The goal is to contribute new insights to the body of knowledge, to enhance what we have to draw on and what gets passed on.

A grand vision emerged in the U.S. after the Second World War. New human-machine knowledge systems could be developed to help researchers consult more of the corpus of all recorded knowledge. Such systems would increase the usefulness of the corpus and accelerate the making of new contributions to it.

[1] The following is a revised version of a paper presented on March 27, 2004 at the "Wissensmanagement in der Wissenschaft" conference in the Institute for Library Science of Humboldt University in Berlin, co-sponsored by the Institute for Library Science and the Society for Science Research. The original version can be seen at http://www.columbia.edu/~hauben/lof-final04.doc. The URL for this version is: http://www.columbia.edu/~hauben/lof-final05.doc

II. Vannevar Bush and the Memex

Vannevar Bush (1890-1974), an American inventor, engineer and science administrator is popularly considered to have initiated this vision in July 1945 with his article "As We May Think."[2] In the 1920s and 1930s, Bush had designed and built the first large scale analog computers. These were used to solve differential equations, being an advanced use of machines to do mental work. During the Second World War, Bush had directed the U.S. Office of Science Research and Development which managed and coordinated the war-related activities of some six thousand U.S. scientists. As the end of the war was coming into sight, Bush saw two problems emerging: 1) how to make the huge volume of war time reports and research findings public and accessible and 2) what new challenge to set for the scientists who would be finishing their war related work. His article "As We May Think" proposed one solution for both problems. Bush proposed the development of mechanical systems to manage and process the growing body of scientific, technical and scholarly information and knowledge.

Bush had great faith in the lasting benefit to human society of scientific and technical development. He welcomed the growing mountain of research. The record must continue to be extended, it must be stored and above all it must be consulted and built upon. To Bush the difficulty was that "publication has been extended far beyond our present ability to make real use of the record." He worried, with so much research and the necessary specialization, that "significant attainments become lost in the mass of the inconsequential."

But there were signs of hope. Bush was at heart a great inventor. He offered as a solution a desk-like device he called "memex," (perhaps for *mem*ory *ex*tension). It would be a mechanized file and personal library system. Using improved microfilm, it would have the capacity to store all the books, documents, pictures, correspondence, notes, etc. that a scholar or scientist might need. The mi-

[2] Bush, V., As We May Think. – In: *The Atlantic Monthly* (Boston). 176 (1945), 1. 101-108. Online at http://www.theatlantic.com/unbound/flashbks/computer/bushf.htm. Reprinted including illustrations from *Life Magazine* in Nyce, J. M. and Kahn, P., (ed), *From Memex to Hypertext: Vannevar Bush and the Mind's Machine*. Boston: Academic Press 1991. 85-110.

crofilm texts would be created by the scholar or received in the mail from colleagues or purchased from publishers or other information providers. The cost would be minimal because the microfilm and mail would be inexpensive. Since the memex would have the capacity to dry photograph whatever the user wrote or placed on its transparent writing surface there was practically no limit to what the scholar could have available. There would be no problem storing even a million books on microfilm in a small space inside the memex. A mechanized rapid selector based on a single frame as an item would allow the call up of any frames or items desired in a very short time. The scholar's work would be facilitated by his or her own personal complete and frequently updated memex library.

But what good is all this personal accumulation of the record? The real heart of the matter for the scholar is to find in the corpus what is relevant and intellectually stimulating. The problem Bush saw that needed to be solved was the method of selection. So far, indexing and cataloguing were done alphabetically or numerically and searching or selecting was by tracing down from subclass to subclass. For example in consulting a dictionary or an index, the first letter is found, then the second, and so on. Such a method Bush wrote was artificial. The human brain does not work that way.

The essence of the memex would be to store, organize and retrieve in a way analogous to the working of the brain. How does the human brain work? It operates, according to Bush's understanding, by *association*. Describing the working of the human brain, Bush observed, "With one item in its grasp, [the brain] snaps instantly to the next that is suggested by the association of thoughts." This is "in accordance with some intricate web of trails carried by the cells of the brain."[3] Recall is sometimes vague and trails not frequently followed are prone to fade with time. Yet the brain is awe-inspiring with its speed of action, intricacy of details and recall of mental pictures.

How could the memex act like the brain? Every time the scholar or scientist puts the microfilm of a book or document into the memex he or she assigns to it a code in the code-book section of the memex. That is the same as before. But, in imitation of the brain, every time the scholar consults a document or item in the memex, the scholar has a mechanism to associate it with other items which come to mind. From then on, the associated items will be able to select each other automatically. The memex puts codes in the margin of the microfilm to insure this action. As the user consults an item in the memex or does his or her scholarly work, trails of association are thus created and recorded for later use. The contents of the memex are in this way organized and coded for retrieval or further research. Every item consulted is associated with other items that are intellectually connected with it. Selection by association replaces indexing. The scholar can annotate the trails, draw conclusions from them and, when satisfied that something worthwhile has been discovered, have the memex make copies of the trail and the documents associated with it. The memex makes the copies photographically on microfilm, in the process a new document is made of the associated frames. The scholar can send the associative trail to his colleagues for insertion of it into their own memexes to be combined with their own trails or the scholar can send it to a publisher for publication.

Bush expected in this way to increase the accessibility and utility of the store of knowledge customized by each user and to facilitate collaboration and dissemination of new knowledge. He also expected, in time, ways would be found so that each memex would learn from the usage of each scholar how to increase the usefulness of its operation. Eventually advanced memexes could be instructed to search for new trails that would be useful to the scholar but which he or she had not yet discovered. In essence, Bush's associative trails were a new knowledge structure and a memex memory coded with associative indexing a new memory structure. Bush expected wholly new forms of encyclopedias would be made, with a mesh of associative trails running through them. A new profession of trailblazers would appear for those who took pleasure in finding useful trails through the enormous mass of the common record. By the easy exchange of microfilmed trails, Bush was hopeful scholarly collaboration and co-work would be facilitated and become common.

Bush expected, having modeled the memex on the working of the brain, the memex would facili-

[3] *Ibid*., Nyce and Kahn. 101.

tate and accelerate scholarly and scientific work. The users of the memex also might improve their own mental processes via its use. The benefit from use of the memex would be achieved without unduly adding to the cost of storage or dissemination because the memex would cause scholarly and scientific publishing to change to microfilm as well. Bush was hopeful in 1945 that the improved knowledge management introduced by memex might yet allow everyone to "encompass the great record and to grow in the wisdom" of human experience.[4]

There is little evidence a memex was ever built. Digitalization replaced microfilm and all-purpose electronic computers became available so that microfilm and photographic methods were no longer considered as the basis for a scholarly workstation. But the idea of associative trails or associative indexing is often sited as the inspiration for hypermedia knowledge structures that have proliferated since the early 1990s. Whether the memex would have ever lived up to Bush's expectations, Bush used it to raise important questions for knowledge management for the sciences: How can the whole corpus of knowledge in a scientist's field be made available to him or her and be kept current? How should it be organized? What method of search and retrieval? And how can knowledge be shared and collaboratively generated? Bush also pointed in the intriguing direction. Look to the master of knowledge management, the human brain for help with knowledge management.

III. Licklider and the Procognitive System

Around 1960, JCR Licklider was recruited to lead a project to inquire into the application of computer technologies to information handling. JCR Licklider (1915-1990) was a physio-psychologist by training. For his PhD in 1942 he had mapped for the first time the different sites in the brains of cats where stimuli from sounds of different frequencies are received. Licklider had also been part of the Wiener cybernetics circle around MIT and had been one of the first people to sit at the console of a mini computer, the PDP-1 and operate it in an interactive mode. The Council on Library Resources which recruited Licklider had been founded and funded by the Ford Foundation in 1956 to address the question how could technology help libraries gather, index, organize, store and make accessible the growing body of recorded information despite the intellectual explosion of the Twentieth Century.

Licklider's project was undertaken at Bolt Beranek and Newman (BBN), the science and technology firm. BBN later became famous for its role in designing and implementing the subnetwork of the U.S. government's ARPANET experiment. Licklider gathered at BBN a small team of engineers and psychologists supplemented by some of his colleagues at MIT.[5] For two years, 1961-1963, they explored "concepts and problems of libraries of the future." Licklider wrote a summary report of the project which appeared as the book, *Libraries of the Future*, in 1965.[6]

Licklider and his team foresaw that the whole corpus of recorded thought, at least in the sciences, law, medicine, technology and the records of business and government could sooner or later be gathered into a single central or distributed computer processable memory system. The BBN study he directed was undertaken to answer the question how might this whole corpus of recorded solid thought be organized and made accessible so that it would be attractive to use and a powerful lever for human progress.

Licklider began his report with an estimate of the size that the corpus of scientific and scholarly knowledge would be in the year 2000. His estimate was of the order of 10^{14} bytes. There seemed in 1965, and there seems today, no technical obstacle to gathering a memory system of this size or even today one or two or three orders of magnitude higher. In terms of recent hardware, 500 memory systems each capable of storing 20TB of data would suffice to hold the whole body of recorded solid thought including digitized audio and video. And there seems no obstacle yet to being able to

[4] *Ibid*., Nyce and Kahn. 107.

[5] At BBN: Fisher S. Black, Richard H. Bolt, Lewis C. Clapp, Jerome I. Elkind, Mario Grignetti, Thomas M. Marill, John W. Senders, and John A. Swets. From MIT: John McCarthy, Marvin Minsky, Bert Bloom, Daniel G. Bobrow, Richard Y. Kain, David Park, and Bert Raphael.

[6] Licklider, JCR, *Libraries of the Future*. Cambridge, MA.: The MIT Press 1965. Available online at http://www.lib.utexas.edu/dlp/licklider/project.html

process in a time of the order of weeks this corpus in any way chosen.

Licklider projected that if it were found possible to process the body of recorded thought so as to have more direct access to its knowledge content, then there would be the basis of a new library system. Such a system would consist of terminals and computers and networks that would make the body of human knowledge available for all possible human needs and for automatic feedback machine control purposes. Licklider chose the name 'procognitive' for the system he was envisioning. *Procognitive* because it would be a system *for* the advancement and application of *knowledge*. Rather than being based on collections of documents and tags and retrieval methods, the Procognitive system would be based on the three elements, the corpus of knowledge, the question, and the answer. There would be no transportation of matter, no books, just (1) processing of information into knowledge and (2) processing of questions into answers, all done digitally. From this point of view, authors and scientists are not seen as contributing documents to science or the Procognitive system. They contribute information or their thoughts which get processed for their knowledge content, augmenting the already existing corpus of knowledge.

How could information be processed into knowledge? How should the corpus of knowledge be organized? Like Bush, Licklider looked to the brain. He recognized that the human brain is a complex arrangement of neuronal elements and processes. These elements and processes "accept diverse stimuli, including spoken and printed sentences and somehow process and store them in ways that support the drawing of inferences and the answering of questions."[7] The human brain (1) processes stimuli at the time of input and (2) stores, not the stimuli but a representation of them. The inferences and answers arrived at by the brain are not mere restatements of past inputs drawn from memory but are tailored to be appropriate to the actual or current need. Licklider also believed, in part, that humans think by "manipulating, modifying, and combining 'schemata,'"[8] or schemes and models of how things work or relate to each other. New knowledge he believed is achieved by adapting one or more old schemata to fit new situations.

Could the body of thought be processed into a new body of knowledge schemata or other knowledge structures? If so, then queries of it could be answered with knowledge structures as answers rather than with already existing documents or parts of documents.

Licklider saw as the aim of the Procognitive system to enable a researcher or scholar, or eventually anyone, to present to the system a search prescription or query or question in more or less natural language and get in return "suggestions, answers to questions, and made-to-order summaries" gathered from the knowledge structures in the corpus of knowledge. The outputs would not be reproductions or mere translations of previous inputs. Licklider expected the outputs to be "of the kind that a good human [research] assistant might prepare if he [or she] had a larger and more accurate memory and could process information faster."[9]

Licklider's BBN project considered or experimented with relational nets, syntactic analyses, the possibility of semantic nets, knowledge "representation languages" and other structures. Based on his sense of how the brain worked, Licklider in the early 1960s considered finding a representation language the most promising way forward. Research was needed to discover the form of the language representation that would be the foundation of a question answering system. Then computer programs and human-computer systems could be worked out that could process the whole corpus of thought and information into the representation or representations that would best capture the knowledge content of the corpus. Licklider expected such a representation language would be more rule-bound than natural language, less ambiguous and would require a larger memory than the natural language text and images-based corpus require.

After the whole corpus of text and images was processed into the chosen knowledge representation form, any new contribution would be similarly processed before it would be added to the processed corpus. This processing even with the most

[7] *Ibid*., 24-25.

[8] *Ibid*., 3.

[9] *Ibid*., 25.

advanced programming would require human-computer interaction. The processing would have to be organized, controlled, monitored and corrected by workers in a new profession, the procognitive "system specialists." For example, the system would issue alert messages when there were ambiguities it could not resolve. The system specialists would then consult the author or editor or subject specialist to find a less ambiguous or clearer representation of the thoughts or information. The system specialists would also undertake to maintain and upgrade the knowledge corpus. They would probe it for statistically unexpected clustering or basic abstract correlations that had not yet been detected. These might imply possible new knowledge structures and would be called to the attention of researchers in the substantive fields but also researchers in the field of knowledge structures. System specialists would also make contribution to the teams of information scientists continually seeking to improve the representation language and processing of information into knowledge.

The substantive users would also contribute to the evolution of the Procognitive system both implicitly and explicitly. Users would be expected to examine the results they receive to their queries or questions and refine their search prescriptions or questions. They would indicate which results they find most insightful by choosing to use some over others. The system's programming code would be open and users would be encouraged, if they wanted, to make suggestions of improvements to the representation language. Licklider expected that substantive users would contribute significantly to the development and improvement of the procognitive system. The system would encourage human-human interaction, group use and easy methods as part of the system to get to other users, to system specialists or to librarians when human help is needed. The Procognitive system would be programmed to utilize such user action as feedback and adapt itself toward the goal of improving future results. Licklider conceived of the Procognitive system as a self-organizing and adaptive 3-way partnership or symbiosis of humans, computer systems and the corpus of knowledge. Each was expected via feedback and adaptation to change and grow. The fundamental purpose of the Procognitive system would be to improve the usefulness and promote the use of the body of knowledge so that human purposes were rewarded with greater success.[10]

Licklider's Procognitive system would process the whole corpus of recorded thought and information in order to capture the semantic relations and content within the data across all discipline lines. Licklider expected that the system could then be addressed and replied to in natural language format. The scholars and other users would receive natural language knowledge responses to their queries and searches. They would still however have to read and think and generate insights and make discoveries beyond what the system provides. The system would provide semantic-like concepts and answers but the humans would make the final and meaningful interpretation. Thus, they could contribute back into the system in an ever-expanding symbiosis. Licklider projected that eventually humans would interact with the growing corpus of knowledge by controlling and monitoring the processing of information and requests into knowl-

[10] Licklider scaled his vision of the procognitve system from his experience in the early 1960s. His experimental system was only big enough to hold three documents. In the 70s and 80s other researchers made progress dealing with databases of abstracts and later of "paragraphs and chapters, tables and pictures, abstracts … references, reviews and notes, catalogs and thesauri." Small scale prototypes of procognitive processing appeared in the 1980s. By the mid 1990s it was possible to use supercomputers to test prototype semantic-like representation language processing of large databases. In one such experiment, the Medline medical abstracts database was processed. The Medline database consisted then of about 9.3 million medical text abstracts. This corpus was processed using a generic noun phrase extractor set of programs. The process yielded over 270 million noun phrases correlated with term co-occurrence frequencies. The 45 million unique phrases where indexed to the abstracts that contained them. A concept space was created as the knowledge corpus testbed for medical queries and searches. Physician collaborators were given access via a web interface to the research prototype system. Their reaction was reported as "highly positive/" Anecdotal evidence was given that searching in the concept space was far more useful and much quicker than searching in human coded indexes. The researches who were doing this work saw it as a beginning prototype implementation "far more semantic than syntactic" of the kind Licklider envisioned. See, Schatz, B. "Information Retrieval in Digital Libraries: Bringing Search to the Net." – In: *Science* (Washington, DC). 275 (1997) 17. 327-334. Online at http://www.canis.uiuc.edu/archive/papers/science-irdl-journal.pdf

edge rather than by handling the details and all of the processing in their own brains. The processing in their own brains would then be doing the most advanced and creative knowledge work.

The success of the Procognitive system Licklider envisioned depends upon one major expectation, the expectation that human-computer systems would be developed that could do highly automated and increasingly sophisticated semantic-like processing. This expectation includes the implication that significant natural language question and answer systems would also be possible. Licklider was writing in the mid 1960s when the field of Artificial Intelligence (AI) was in its promising infancy. Was Licklider like many of the people with whom he was working too optimistic about AI? Licklider explicitly explains that the success of the future procognitive systems would not depend upon breakthroughs in AI. He did not expect that the procognitive system needed "intelligent" contributions from computers. He wrote, "… useful information-processing services can be made available … without programming computers to 'think' on their own."[11] Licklider had the intuition that semantic analysis and processing would be much more important then the syntactical research that was current in the 1960s. But he also felt that the line dividing syntactics from semantics might not be a sharp line. He suggested that as more subtle syntactical analyses were attempted and computers became more powerful, syntactic analyses might begin to show semantic aspects. Licklider had "no thought that syntactic analysis alone – whether by man or machine – is sufficient to provide a useful approximation to understanding."[12] On the other hand, he wondered, "… as subtler and subtler distinctions are made in the process now called syntactic analysis, [whether] that process will start to become semantic as well as syntactic."[13]

Licklider's intuition and vision was that syntactic processing would continue to increase in sophistication while hardware and network developments would likely make semantic-like knowledge processing possible. The research question Licklider left to be answered was what knowledge structures or forms or correlations or representations would prove most fruitful for the organization of the corpus of knowledge. For Licklider the library of the future was even more of a human-machine-knowledge symbiosis than Vannevar Bush had envisioned. Licklider also raised the social/political questions, would society set itself the goal of developing a procognitive system, would all the holders of digitized information share their holdings without restriction, would society resist the commercial pressure to keep knowledge proprietary?

V. The Google System, Syntactics and Semantics

The visions of libraries of the future examined above were articulated from 1945 to 1965 and projected ahead to the year 2000. If we jump ahead to the beginning of the twenty-first Century, the body of knowledge is being put more and more into digital form. That body is divided into at least two forms. There is the web page record accessible via browser and search engine of some billions of web pages of information. There is also a growing body of scholarly information processed into digital form by digital library projects or produced in digital form by publishers. Some of this body is in web form but much of it is in databases that are not reached by search engines. This divide will close as more digital library resources become available to search engine indexing systems.[14] The most popular method in 2004 for scholarly interaction with the corpus of knowledge available on the web is the Google, Inc. system. Even some scientists report more relevant and useful hits using the Google search engine than they find in specialized scientific search programs.[15] An article in *Science* traces the technology that is the foundation for

[11] *Ibid.*, *Libraries of the Future*, 58-59.

[12] *Ibid.*, 131.

[13] *Ibid.*, 141.

[14] Young, J. "Libraries Try to Widen Google's Eyes." — In: *The Chronicle of Higher Education* (Washington, DC). L (2004) 37. A1, A31-A32. Online with restricted access at: http://chronicle.com/weekly/v50/i37/37a00101.htm

[15] Arms, W. "Automated Digital Libraries: How Effectively Can Computers Be Used for the Skilled Tasks of Professional Librarianship?" — In: *D-Lib Magazine* (Reston, Va). 6 (2000) 7/8. Online at http://www.dlib.org/july00/arms/07arms.html

such search engines as Google directly to the work of Licklider in the 1960s.[16]

The Google search engine was developed by graduate students as an open system.[17] The U.S. National Science Foundation encouraged the graduate students to make their work proprietary, violating the original public essence of the Google project. The current secret nature of the Goggle system and its for-profit purpose bring Google, Inc. into conflict with the open essence of the Internet, Usenet and the procognitive system envisioned by Licklider. Still, the success of this search engine raises a question related to Licklider's intuition about syntactic and semantic processing.

The Google "web crawlers" are data analysis programs that download into a database and process upwards of a billion or more web pages every few weeks. They gather the words on each page (except for junk words) and make inverse indexes attaching to each word the URL of the web pages where it appears. They keep track of the position in the text where each word appears. They also index the URLs according to how frequently they are linked to and from other pages, giving greater weight to links from higher-ranking pages. This indexing of the URLs requires processing matrices of the order of a billion times a billion. But Google's algorithms and computers perform these calculations routinely. The Google system also gives weight to font size and other formatting details. None of Google's processing is semantic. There is no intelligence in Google's indexes. Yet most users find the Google system powerful in quickly finding for them and ordering with a fair degree of relevancy web page sources that meet their search criteria.

Now envision as Licklider did if thesauri were generated which linked to each word in a search engine index other words related to it as synonyms or as equivalents from other fields of study and other relations. Envision if the words were linked to noun phrase and term switching databases, if statistics of term co-occurrence and density and clustering were added for each page. Then the word and phrase and natural language queries and searches could draw all at once on these factors. Might we then be getting closer to matching concepts in the users brain with concepts in the web page record? And envision what would result if we added to the web page record all possible databases and processed images and sound tracks. Would that not be closer to the semantic-like interaction with the whole corpus of knowledge at the heart of the Procognitive system?[18]

VI. Conclusion

The visions from 1945 to 1965 suggested above resulted from the question of how to collect and organize and process the scholarly record so that it would be more accessible and attractive for the accomplishment of scientific and scholarly work. Bush and Licklider were technology enthusiasts who foresaw that the essence of a library, its organized knowledge content, need not be located in books or buildings. They shared a sense of the value of access to the whole corpus. They set the high goal for library and computer and knowledge scientists of developing a single human-machine-knowledge system that would make the body of knowledge more useful and accessible. There has been in the last 15 years a vast effort at digital libraries research. Some of this research has adopted this goal. Perhaps a human-machine-knowledge system like Licklider's Procognitive system will serve as a grand vision that will inform more digital libraries research and eventually lead to the enhancement of human life by giving all people a chance to benefit from intimate contact with the whole body of knowledge.

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[16] Schatz, *Ibid* note 10. (http://www.canis.uiuc.edu/archive/papers/science-irdl-journal.pdf)

[17] Brin, S. and Page, L. "The Anatomy of a Large Scale Hypertextual Web Search Engine." – In: *Proc. The 7th International WWW Conference* (Brisbane, Australia). 1998. Online at: http://www-db.stanford.edu/pub/papers/google.pdf

[18] Schatz wrote in 1997, "By 2010, the vision will be realized with concept search enabling semantic retrieval across large collections … Information retrieval in the next century will be far more semantic than syntactic, searching concepts rather than words." *Ibid.*, Note 10. 327. http://www.canis.uiuc.edu/archive/papers/science-irdl-journal.pdf

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A Brief History of the Internet in Korea

by Kilnam Chon[1], Hyunje Park[2], Kyungran Kang[3], and Youngeum Lee[4]

Abstract

The TCP/IP network in South Korea started in May 1982, one of the earliest Internet deployments in the world. The initial TCP/IP network, called SDN, consisted of two nodes with 1200 bps bandwidth.

SDN served the research and education community with a primary focus on network research, and had international links with UUCP initially. The international links cover several countries in Asia, which are together called AsiaNet, as well as Europe and North America.

In parallel to TCP/IP development, communications on personal computers using bulletin boards and others also proliferated. These two network developments along with availability of WWW made for explosive Internet growth in the 1990s. These developments resulted in the leading broadband country with various applications. The Internet is becoming the social infrastructure in Korea lately with many aspects of daily life are done through the Internet including social and political activities. Convergence of the Internet with telecommunications and broadcasting is taking place now.

1. The Pre-Internet Period

Basic Internet Technologies and Concepts Proposed

The 1960s was the period that saw the birth of technologies and concepts that were to become the foundation of the Internet. In 1965, the concept of "packet switching," which was to become the fundamental technology of the Internet, was proposed.

Domestic Network Developments

During the period between the late 1960s and 1970s, efforts to construct domestic computer networks were launched in countries such as France, UK, and USA. The most notable one is ARPANET (Advanced Research Project Agency Network) in USA in 1969.

2. Birth of the Korean Internet, SDN

SDN Begins Operation

Korea's first Internet system, SDN (System Development Network) began its operations on 15 May 1982. A computer at the Department of Computer Science at Seoul National University was connected to another computer at Korea Institute of Electronics Technology (KIET) in Gumi (presently ETRI, Electronics and Telecommunications Research Institute) via a 1200 bps leased line, and in January 1983, a third computer at KAIST (Korea Advanced Institute of Science and Technology) was connected to the SDN, which resulted in a system that could be described as a network of computers. Since TCP/IP is one of the communications protocols used among the computers connected to the SDN, this can be noted as Korea's first Internet.

UUCP and USENET

SDN was connected to the mcvax in the Netherlands in August 1983 by using UUCP (Unix-to-Unix-Copy), and in October of the same year, it was connected to the hplabs in the United States. Since UUCP was a protocol that was already installed in UNIX computers, there was the advantage of not having to install additional protocols, and thus SDN Connectivity could be expanded not only to overseas computers but also to domestic computer nodes with relative ease.

In the U. S., CSNET (Computer Science Network), a network that connected universities and research institutions that had not participated in ARPANET, had been constructed. SDN was connected to CSNET in December 1984, and this connection was utilized as a forum for exchange of technology until SDN was formally connected to the U.S. Internet in 1990. However, services such as the FTP could not be used because of the U.S. government restrictions on connections to the

ARPANET. Thus, only e-mail and news (USENET) services were available with USA. Moreover, because of the extreme high cost of international phone lines, a large portion of the USENET data had to be received in magnetic tape format by regular postal mail rather than via online connections.

Hangeul e-mail

In 1983, a Masters thesis on the development of a mail system using the Korean character set was reported in KAIST, and experiments on e-mail using the Korean character set was initiated. In 1985 a Korean e-mail program and a Korean editor program, called hvi were developed, enabling people to send and receive e-mail using Korean characters through SDN. In addition, in May 1984, Dacom began its commercial e-mail service through DACOM-net.

AsiaNet

From 1983, SDN was connected to various sites in Asia in addition to North America (hplabs and seismo in USA, CDNNET in Canada), and Europe (mcvax in the Netherlands). The network linking Asian countries was called AsiaNet, and included Australia, Indonesia, Japan, Korea, and Singapore.

3. Global Internet Connection, early 1980s

Use of the .kr Domain and IP Address

In the mid-80s, the progression of a series of critical events enabled the Internet in Korea to meaningfully participate in the global Internet. In July 1986, the first IP address (128.134.0.0) for Korea was assigned. In 1986, rules for second and third level domains under the .kr domain were established and the country code top level domain to represent Korea, .kr, was formally in operation. Also, computers in KAIST and others were registered as the domain name server for the .kr domain (for example, sorak.kaist.ac.kr) establishing the infrastructure for allowing not only domestic but also international open access to the computers using .kr as its domain name.

Establishment of Internet Policy Centers

As the use of the Internet expanded to domestic and then to the international networks, there was a need to establish a mechanism to systematically and efficiently manage Korea's domestic Internet use. Thus the ANC (Academic Network Committee) was formed in 1988 as the association that would perform this function. The ANC was composed of the ANC Steering Committee, consisting of representatives of ANC and other necessary committee members, and its technical subcommittee, the SG-INET, consisting of members involved in the everyday operations of networks. The ANC assumed the role of representing the Korean Internet society, and was involved in managing the use and assignment of domestic domain names and IP addresses as well as connections with overseas networks, and represented Korea in international network associations. The ANC changed its name to KNC (Korea Network Committee) in 1994 and then to NNC (Number and Name Committee) in 1998, and continued to operate as a civil organization establishing and recommending domestic Internet policies.

PC Communications

In addition to efforts to provide network services centered on the Internet, another type of network service was developed in the 1980s. This was PC communications, which began in 1984 as Dacoms Hangeul Mail, and then was consolidated in 1986 as Chollian. The KETEL (Korea Economic Daily Telepress) service that began in 1988 was reorganized as Hitel and became the most prominent PC communications service. This type of online communication using PC communications operated as a separate service independent from the Internet until 1995 when regular PC network users were able to connect to the Internet using commercial networks. The most notable significance of the PC communications is that it contributed to the development of the concept of online communities.

The PACCOM Project

In 1989, the University of Hawaii was the focal point of the plan for PACCOM (Pacific Communications Networking Project), connecting Australia, Hawaii, Japan, Korea, and New Zealand. In Korea, many member institutions of SDN agreed to jointly fund the 56 Kbps leased line to Hawaii, and established an organization named HANA for this purpose. In March 1990, a computer at KAIST was connected to the University of Hawaii via a satellite at 56 Kbps, and the HANAnet was constructed. Until then, charges for international connections to UUCP, and CSNET were based on the number of data packets. Thus, international Internet connections were highly limited. But after the establishment of connections with PACCOM people could use it with relatively few limitations. Data traffic figures for Internet applications during this time show the highest usage in FTP, followed by Mail, Telnet, Archie, and DNS. In August 1992, The main gateway equipment and the operation of the HANAnet and SDN were transferred from KAIST to KT (Korea Telecom). Thenceforth, HANAnet of the KT research center gave birth to KORNET, KTs commercial Internet services. After the construction of HANAnet, SDN was used to designate domestic networks and HANAnet was used to designate networks connected to the global Internet. The name SDN slowly lost recognition, resulting in the decision by ANC in 1993 to no longer use the SDN name.

PCCS (Pacific Computer Communications Symposium 1985)

In 1985, a conference focusing on computer networks, PCCS (Pacific Computer Communications Symposium), which was one of the world's first conferences on the Internet, was held in Seoul, with approximately 300 Internet experts participating from Asia, Europe and North America.

Considering that the next global conference on the Internet was held in the early 1990s, this conference was a highly advanced conference. This also displays the active and leading role played by Korea in the global Internet field. In addition, the PCCS provided the impetus for the annual meeting of JWCC (Joint Workshop on Computer Communications), a meeting of Asian computer network experts which was held annually with the meeting venue alternating between Japan and Korea initially. The number of participants of the JWCC expanded gradually, resulting in its development into ICOIN (International Conference on Information Networks).

4. Proliferation of the Internet among Research & Education Community, early 1990s

National Infrastructure Project

In July 1983, the plan for Five National Information Network Project which included National Administrative Information Network, and Education and Research Network Infrastructure among others was established, and the legal basis for pursuing the plan was put in place by legislation of Legislature #3848, "Law on Expansion of Network Infrastructure and Use" on 12 May 1986. Based on this law, the government of Korea established a Committee on Management of Networks to evaluate and manage policies related to the construction of the national information networks and began a government-led construction of the national information network.

In June 1988, it was decided that construction of the Research and Education Network, one of the national information networks would be divided into the Research Network and the Education Network. The Research Network was operated by the System Engineering Center (presently KISTI) which belongs to the Ministry of Science and Technology, and the Education Network was operated by Seoul National University which belongs to the Ministry of Education, and the construction of each network was launched. Both networks, the Research Network, KREONet (Korea Research Environment Open Network) and the Educational Network, KREN (Korea Research and Education Network), are still currently being used to connect many research centers and universities, respectively.

Voluntary Research on Network Technology by Experts

SG-INET was established in 1991 to perform the role of developing, implementing, and operating technologies by establishing subcommittees of working groups on naming, routing, Hangeul, and security. The activities of these working groups resulted in many achievements such as: the naming working group providing the fundamental infrastructure for the establishment of KRNIC, the Hangeul working group developing the IETF standard for Hangeul mail, and the security working group establishing CERT Korea. Many experts in network operation organizations such as KREN, KREONET, KAIST, ETRI, SNU, NCA, Dacom, KT, Samsung and Goldstar participated in SG-INET.

KRNIC

In 1992, the Korea Network Information Center was established in order to provide a network information management function for all Internet services that had been under the supervision of ANC. Up to that point, the registration of domain names on the Internet and administration of network information had been performed on an individual network basis. However, because the magnitude of domestic Internet was growing and because there was a global trend for establishing network information centers within continents as well as individual nations, the Korea Network Information Center was founded. KAIST had been consigned to run the Korea Network Information Center since January 1993, In September 1994, its central functions were transferred to the National Computerization Agency, and in June 1999, an independent corporation named KRNIC was created to take complete charge of domestic network information administration functions. In 2004, based on the Internet Address Resources Law, the National Internet Development Agency of Korea was founded in order to perform the administrative function of Korea's domestic Internet address resources.

Standardization of Hangeul Encoding

Existing e-mail programs were able to deliver mail without error only when Roman characters and numbers were used, and mail sent in Korean characters was damaged, making it impossible for the receiver to read mail sent in Korean characters. In December 1991, a Korean mail program, Hangeul elm, was developed according to the Hangeul Encoding Standards (ISO2022-KR) which designated principles for encoding Korean Hangeul characters into Roman characters and numbers without corrupting the content. The encoding method used for this program was then further developed and recorded as an RFC document of the IETF (The Internet Engineering Task Force) in 1993 under the title, Korean Character Encoding for Internet Messages, which was the first RFC document by a Korean submitted to IETF.

World Wide Web Begins

In the 1990s the global Internet experienced a revolutionary transformation in the Internet technology called the World Wide Web, and in Korea the first web site, cair.kaist.ac.kr, was set up and operated at the Center for Artificial Intelligence Research (CAIR) at KAIST in 1993.

KRNET

1990s was a period when Internet technology made a dramatic development globally as well as domestically. One reflection of this could be found in the first KRNET (Korea Network Workshop) held in Seoul in 1993. This workshop continues to be held annually, providing a forum for introducing new trends in Internet related technology, facilitating exchange of technology, and promoting cooperation among technical experts.

5. Commercial Internet

Commercial Internet Service Begins

In the mid 1990s the Internet, which had been restricted for use in universities and research institutions only up to that point, became available to businesses and individuals. Several commercial Internet services were initiated in 1994, beginning with KORNET by Korea Telecom in June, 'DACOM InterNet' by Dacom in October, and nuri.net by Inet Technologies in conjunction with Nowcom in November. Commercial Internet services have since developed into a major industry in Korea, with approximately 30 Internet service providers in operation in 2004.

KIX - Commercial Internet eXchange

In order to have the commercial Internet service providers operate with other Internet service providers, the National Computerization Agency established an exchange, called KIX (Korea Internet eXchange). The first step was to connect the Educational Network and the Research Network in February 1995, and after March, eleven commercial Internet Service Providers (ISPs) such as Inet and Nowcom were connected. In November that year, an agreement was made for an IX

(Internet Exchanger) system that would have the National Computerization Agency (NCA), Korea Telecom, and Dacom be the hub (i.e., IX) for connecting and managing domestic Internet, and commercial ISPs were transferred to the commercial Ixs (Korea Telecom, Dacom) by December 1996. Also, in June 1999, the Korea Internet eXchange Association, composed of many ISPs, set up a neutral Internet exchange named KINX (Korea Internet Neutral eXchange).

Internet and the Mass Media

In March 1995, the *Joongang Daily News* began its first Internet news service and in October that year the *Chosun Daily News* launched its Digital Chosun Daily News. Moreover, webzines (short for web magazines), news sites that exist independently, not in conjunction with printed newspapers, were introduced in September 1996 with the launching of im@ge by Inet and rapidly began to proliferate. In addition, in 1996, the era of e-commerce, where things could be searched and purchased from the web sites instead of at the stores, began with the opening of Interpark and Internet Lotte Department Store.

Internet Expo

The 1990s was a period when the Internet was rapidly becoming popularized. In 1996, an international Internet Expo was held on the Internet, a global event held with the purpose of encouraging the expansion of Internet use and to utilize the Internet that had been constructed. This event provided a range of opportunities for experimenting with the rapidly developing WWW technology and other Internet technologies by using a web site on the Internet as the gallery in place of a physical one. In Korea, this was an opportunity for the venture businesses to introduce their technologies domestically as well as internationally and further develop them, as well as an occasion for encouraging the news media to be involved in online operations. In addition, this provided the momentum for encouraging public organizations in Korea to establish web sites.

Internet Ventures

Many ventures on the Internet started their operations in 1990s as the commercial Internet service was deployed. Some of them led the Internet industry, and they include: Ahn Chul Soo Laboratory virus protection; Daum, a portal site with E-mail service; NCsoft and Nexon, online games, and Naver/NHN, search engine.

6. Broadband Internet

Widespread Availability of Broadband Internet

Until the late 1990s, individual home users of the Internet had a maximum connection speed of only 64 Kbps with dial-up service. However, this changed when Thrunet began to provide broadband Internet services in July 1998 with approximately 1Mbps connection speed using cable TV networks, and Hanaro Telecom and KT joined in the broadband Internet provider race through the use of ADSL (Asymmetric Digital Subscriber Line) technology. In 2004 the number of home users with broadband Internet access exceeded 11 million, which covers more than 70% of the households in Korea. The widespread availability of broadband Internet services provided the impetus for Korea to become the leading Internet stronghold nation of the world. Such a leap in the development of broadband Internet stimulated the expansion of various multimedia services and provided the foundation for an evolution into a ubiquitous networking made possible by a convergence of broadcasting and telecommunication and wireless Internet services provided by mobile phones as well as broadband Internet.

Factors in the Expansion of Broadband Internet

In the late 1990s when demand for services provided by the Internet was increasing but Internet access from individual homes was not common, Internet cafés, or 'PC bangs' that provide the general public with Internet access began to appear. The first domestic Internet café, NET began operating in Seoul on 15 September 1995. The number of Internet cafes gradually increased, reaching 15,150 by the end of 1999. In addition, the number of online gamers increased, and PC bangs were at the core of such a phenomenon. In 1998, an online war simulation game called Starcraft was widely played by the general public, and PC bangs were the centers for such games. Youth in their teens and 20s provided the impetus for the increase in demand for online games, and it could be said that such a demand contributed greatly to the distribution of Internet access to individual homes.

Online stock-trading based on the Internet enabled easy stock trading without having to physically visit the stock brokerage. Internet banking services enabled withdrawal or transfer of funds without visiting the bank. Because it was so convenient, approximately 11,310,000 users, which are about 30% of the total population as of November 2001, were found to be registered users of Internet banking.

7. Social Impact of the Internet

Negative Impact of the Internet

Although the Internet is making lives more convenient, it also has negative impacts on Korean society. There is an increase in the number of people who are addicted to specific services on the Internet, most notably online games and indecent information, and are unable to lead normal everyday lives. There are web sites that plan suicides and actually carry them out. Criminal acts of obtaining and using other people's personal information by means such as hacking has occurred. In addition, there are other negative incidents on the Internet such as the bombardment of unrestricted spam mail that unnecessarily consumes people's time and the spreading of computer viruses through e-mails, obstructing business operations.

Governmental Efforts

In 1995, the Ministry of Information and Communication (MIC) established the Information Communication Ethics Committee in order to prevent and evaluate the negative effects of network communication. In addition, institutions such as the Internet Crime Investigation Center, Center for Internet Addiction, and Korea Spam Response Center were established by cooperative efforts between the government and civil societies and are involved in activities aimed at circumventing the negative effects.

Balance between Individual Freedom and Regulation of Negative Impacts

Efforts to address the negative impact of the Internet have the danger of infringing on an individual's freedom, and additional efforts to thwart such dangers have been concurrently pursued. In 2000, the Ministry of Information and Communication (MIC) attempted to legislate the Internet Content Rating System when it was revising the Act on Promotion of Information and Communication Network Utilization and Information Protection. But this effort was annulled due to citizen opposition. Article 53 of the aforementioned act that allowed an order of the Minister of Information and Communication to place certain restrictions on electronic and telecommunication businesses in dealing with certain types of information was ruled partially unconstitutional in 2002.

8. Netizens

It was in the early 1990s that individuals of the general public were able to express their political and social opinions through the Internet. As part of its support program for developing countries, 'Sustainable Development Network Program (SDNP),' the UN established SDNPs in many countries including the one in Korea, which was hosted by YMCA. The anonymity and easy access afforded by the Internet prompted various people to set up and operate web sites and express more diverse views. In August 1997, the supporter club for the national soccer team selected the Red Devils as its official name, and in November 2000, the Red Devils opened its home page and provided the major impetus for the massive cheering crowds in the 2002 FIFA World Cup Games in Korea-Japan. When two middle school girls were killed by a U.S. armored tank in June 2002, on-the-street candle light vigils by netizens and online memorials spread throughout the country. In addition, during the December 2002 presidential election, there were many active online and offline campaigns organized and played out by many netizen groups such as a support club for Mr. No Moo Hyun, People Who Love No Moo Hyun (Nosamo). These netizen groups did not spring up suddenly with the introduction of the Internet. Rather, they are extensions of online communities that were formed through the PC communications in the early 1990s, using the Internet as their newer communication medium.

Notes

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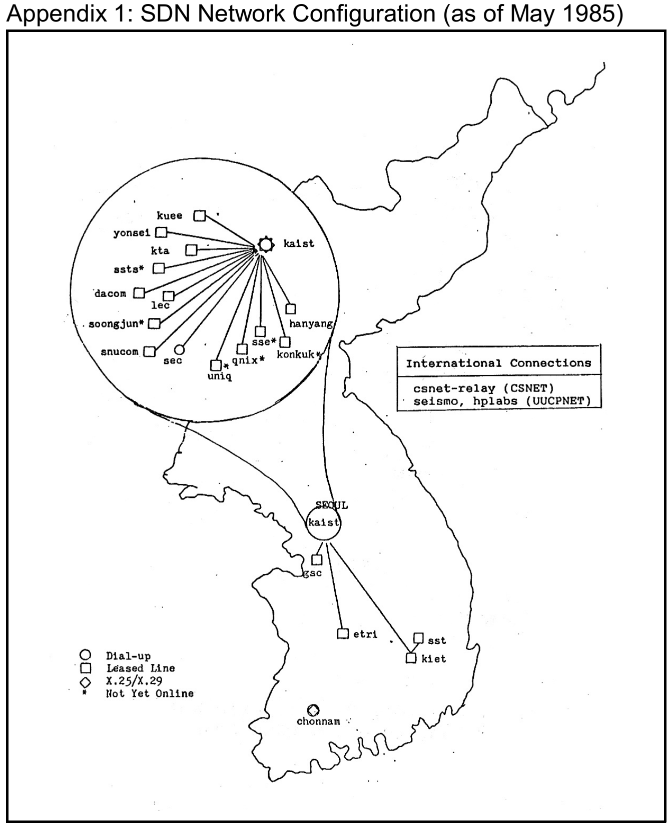
Abbreviations

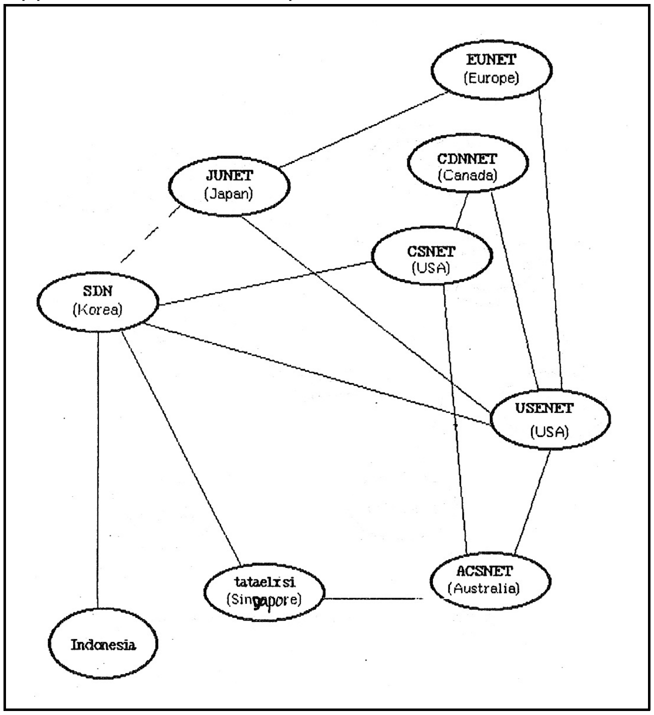
ADSL	Asymmetric Digital Subscriber Line
ANC	Academic Network Committee
CAIR	Center for Artificial Intelligence Research
DNS	Domain Name Service
ETRI	Electronics and Telecommunication Research Institute
FTP	File Transfer Protocol
ICOIN	International Conference on Information Network
IETF	Internet Engineering Task Force
IX	Internet Exchange
ISP	Internet Service Provider
JWCC	Joint Workshop on Computer Communications
KAIST	Korea Advanced Institute of Science and Technology
KINX	Korea Internet Neutral eXchange
KIX	Korea Internet eXchange
KNC	Korea Network Committee
KRNIC	Korea Network Information Center
KREONET	Korea Research Environment Open Network
KREN	Korea Research and Education Network
KRNET	Korea Network Workshop
NNC	Number and Name Committee
PACCOM	Pacific Communications Networking Project
PCCS	Pacific Computer Communications Symposium
RFC	Request For Comment
SDN	System Development Network
SDNP	Sustainable Development Network Program
UUCP	Unix-to-Unix Copy
WWW	World Wide Web

Appendix

Appendix 1: SDN Network Configuration (as of May 1985)



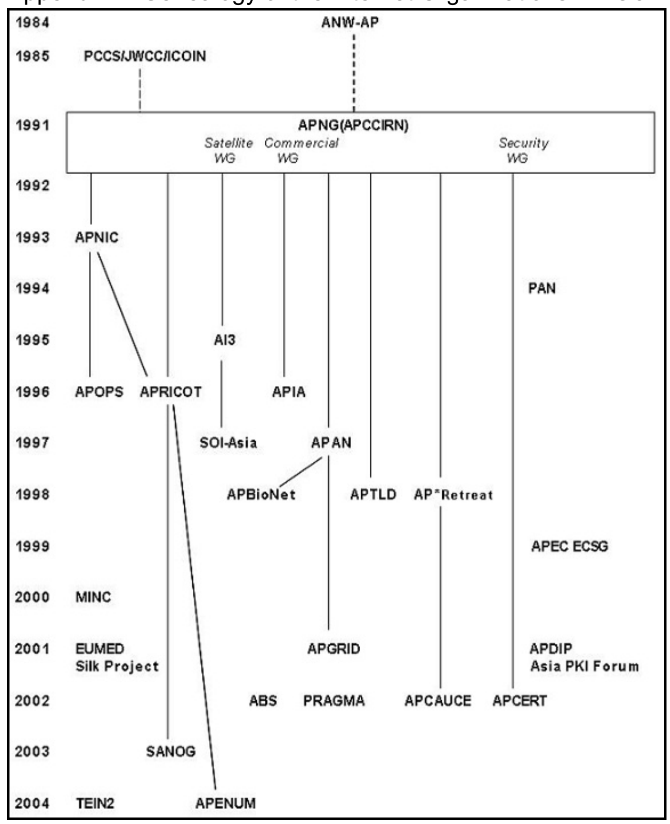
Appendix 2: AsiaNet Map



Appendix 3: Internet History Yearly Table (1969~2004)

Year	Infra/Business	Media/Community	Society/Law/ Organization
1982	SDN(TCP/IP)		
1983	UUCP/USENET Hangeul E-mail		
1984	CSNET(X.25)		
1985	Commercial Hangeul E-mail		
1986	.kr domain	PC Communica-tions	Law on Information Network Promotion
1987			NCA
1988		Brain Virus	ANC(KNC)
1989			
1990	Global IP Connection		
1991			
1992			KRNIC
1993	First RFC	First Website	KRNET
1994	Commercial ISP	First Online Game	Websites for Public Organization
1995	Internet Exchange (KIX)	Internet Mass Media	ICEC
1996	Electronic Commerce		Internet Expo 96
1997	Online Stock Trade	hanmail	Internet Association of Korea
1998		Starcraft	
1999	Internet Café (~10,000)	Daum Café	
2000			Internet Suicide Websites
2001	Internet Banking (~11 million users)		Internet Crime Inves-tigation Center
2002	Broadband Internet (~11 million users)	Netizens	Center for Internet Addiction
2003	1.25 Internet Slam-mer Worm Virus		Korea Spam Response Center

Appendix 4: Genealogy of the Internet Organizations in Asia



Appendix 5: A Brief History of the Internet in Asia

1. The Pre-Internet Period

The 1960s was the period that saw the birth of technologies and concepts that were to become the foundation of the Internet. In the 1960s, the concept of packet switching, which was to become the fundamental technology of the Internet, was proposed.

During the period between the late 1960s and early 1970s, efforts to construct domestic computer networks were launched in countries such as France, UK, and USA. The most notable one is ARPANET (Advanced Research Project Agency Network) in USA in 1969.

In Asia, similar efforts to develop computer networks were launched in the 1970s and 1980s. They include

CSIRONET and N-1 Network in Australia, and Japan, respectively.

2. Initial Regional Coordination

ANW-AP (Academic Networkshop - Asia Pacific)

The (International) Academic Networkshop was one of the early coordination meetings on the internet globally, and had the first meeting in 1982. Asia started participation in the meeting from 1983. The first Asian coordination meeting, ANW-AP was held during the 1984 ANW, and Australia, Japan and Korea participated at the meeting.

AsiaNet

In the 1980s, there was much development of UUCP-based computer networks in Asia as well as in other continents. These domestic UUCP networks in Asia were linked internationally including Australia, Indonesia, Japan, Korea and Singapore in 1983, and the international UUCP-based network in Asia was called AsiaNet. It was used for E-mail and news. AsiaNet was also linked to North America (seismo and hplabs) and Europe (mcvax).

PCCS (Pacific Computer Communications Symposium 1985)

In 1985, a conference focusing on computer networks, PCCS (Pacific Computer Communications Symposium), which was one of the world's first conferences to address the Internet, was held in Seoul, with approximately 300 Internet experts participating from Asia, Europe and North America. Joint Network Meeting was held during the Symposium with presentations of research and education networks in Australia, Japan, and Korea as well as European networks. Other countries and economies such as China, Indonesia, Singapore, and Taiwan participated at the meeting, too.

In addition, the PCCS provided the impetus for the annual meeting of JWCC (Joint Workshop on Computer Communications), a meeting of Asian computer network experts which was held annually with the meeting venue alternating between Japan and Korea initially. The number of participants of the JWCC expanded gradually, resulting in its development into ICOIN (International Conference on Information Networks).

3. Prolification of the Internet for Research and Education Community

The first Internet in Asia

Korea's first Internet with IPv4, SDN (System Development Network), began its operation in 1982 with two nodes. The international link to USA was done with UUCP since the direct international link with IP was not permitted in USA. Other countries followed the development of IPv4-based computer networks in 1980s and beyond.

Campus Network

With prolification of Unix machines (minicomputers, workstations, PCs) and local area networks, the Internet became common among universities in mid to late 1980s. The BSD (Berkeley Software Distribution) version of UNIX, which includes TCP/IP protocols played a major role in the prolification of the IP-based campus network then. Networking between universities were normally handled by UUCP protocol, which was also readily available by mid-80s.

PACCOM (Pacific Communications Networking Project)

The direct international link with IP to USA was permitted later in the decade. With PACCOM (Pacific Communications Networking) Project in 1989, several countries connected to USA through Hawaii. They include Australia, Japan, Korea, and New Zealand. Many other countries connected to the U.S. Internet in 1990s with their domestic Internet development.

BITNet Asia

BITNet Asia, another computer network for the research and education community was developed in 1980s with the IBM network protocol to connect IBM mainframe computers of central computer centers among Asian universities. The network eventually changed its protocol to the Internet protocol in the 1990s to fully connect to the Internet.

UUCP Network

UUCP-based networks were extensively deployed in Asia starting from AsiaNet in early 1980s.

These networks also changed their protocols to the Internet protocol in the 1980s and 1990s as their traffic increased.

4. APNG, The First Regional Internet Group

CCIRN (Coordinating Committee for Inter-Continental Research Networking)

CCIRN (Coordinating Committee for Inter-Continental Research Networking) was spawned from the (International) Academic Networkshop to coordinate international links between Europe and North America, and had its first meeting in 1987. Later, Asia was invited to participate, and APCCIRN was created to coordinate CCIRN participation, and had its first meeting in 1991.

APCCIRN/APNG

Since APCCIRN was the only coordinating body in Asia on the Internet then, it ended up coordinating various matters on the Internet. The first matter was the creation of the regional IP registry, APNIC, which was formally started in 1993. Later, APCCIRN was renamed to APNG (Asia Pacific Networking Group), which spun off many organizations in the 1980s and 1990s. See Appendix: Genealogy of Internet Organizations in Asia Pacific for detail. It is currently operating APNG Camp among others.

INET

The (International) Academic Networkshop had its last annual meeting in Australia in 1989. Its successor, INET had its first annual meeting in Copenhagen in 1991, followed by Kobe in 1992, Many Asians participated in INET Conferences, and various coordination efforts took place during INET Conferences.

5. APNIC, Regional IP Address Registry

Asia Pacific Network Information Center (APNIC) was created in 1983 to handle regional coordination and IP registry for Asia. APNIC and its counterparts, RIPE NCC in Europe, ARIN in North America, LACNIC in Latin America, and AfriNIC in Africa coordinate the worldwide IP registry.

6. APRICOT, Regional Internet Conference on Operational Technologies

Asia Pacific Regional Internet Conference on Operational Technologies (APRICOT) was created by volunteers of APNIC, APNG, and others to provide a forum for those key Internet builders in the region to learn from their peers and other leaders in the Internet community from around the world, and had its first annual conference in 1996 in Singapore. APRICOT is managed by APIA, another spinoff from APNG as APNG Commercial WG.

7. Regional Research and Education Networks

There were two new major initiatives in mid-1990s to develop regional research and education networks; APAN (Asia Pacific Network Consortium), and AI3 (Asia Internet Interconnection Initiative Project).

AI3

AI3 was kicked off in 1995 by WIDE Project and JSAT in Japan. It has been operating a satellite based testbed network in South East Asia and producing a series of research activities using the testbed. With its companion project called SOI- Asia (School of Internet-Asia), which is also based on satellites, more than 10 countries in South and Southeast Asia are linked to provide precious communication resources for research and education communities.

APAN

APEC Symposium was held in 1996 to discuss gigabit networking among others. The subsequent meeting on the gigabit networking at APII Testbed Forum in 1997 resulted in the formation of APAN. APAN Consortium addresses a high-performance network for research and development on advanced next generation applications and services.

8. APTLD, Regional Domain Name Coordination

International Forum on the White Paper (IFWP) was held around the world in 1997-1998 to discuss the creation of the international governance body for Internet domain names, IP registry, and the root servers among others, and ICANN (Internet Corporation for Assigned Names and Numbers) was created. During these meetings, the consensus was developed to form a regional body to address country-code top-level domain names (ccTLD). APTLD was established in 1998 to work as the forum of information exchange regarding technological and operational issues of domain names registries in Asia Pacific regions.

9. AP* Retreat, Common for Information Exchange and Discussion

By late 1990s, there are many Internet-related organizations in Asia Pacific, and a common forum to exchange information between these organizations and discuss the relevant issues became necessary. The fist meeting was held in 1998. Since then, AP* Retreat was held during APRICOT in winter and APAN in summer every year.

10. Internationalized Domain Names

The internationalization of the Internet became very important as the Internet became common in the world. In order to further the Internet internationalization, the Internationalized domain name (IDN) project was started in Asia, and IETF decided to standardize on IDN in late 1990s. Subsequently a set of the standards on IDN was completed in early 2000s. During the period of IDN development, several organizations were created to address IDN issues including MINC (Multilingual Internet Name Consortium), CDNC (Chinese Domain Name Consortium), and JET (Joint Engineering Team) in addition to INFITT, for addresses in Tamil Language and Arabic language group.

11. Governmental Initiatives

APEC(Asia Pacific Economic Cooperation)

With creation of APEC (Asia Pacific Economic Cooperation), various activities related to the Internet were started. The most noteworthy activities include APEC Tel WG on telecommunications and EC SG on e-commerce. These groups were created in 1990 and 1999 respectively.

UNDP(United Nations Development Programme)

The Asia-Pacific Development Information Programme (APDIP) is an initiative of the United Nations Development Programme (UNDP) that aims to promote the development and application of new information and communication technologies for poverty alleviation and sustainable human development in the Asia-Pacific region.

IDRC (International Development Research Centre)

PAN (Pan Asia Networking) is an IDRC program to seek to understand the positive and negative impacts of information communication technologies (ICTs) on people, culture, the economy, and society, so as to strengthen ICT uses that promote sustainable development on the Asian continent. IDRC renamed the above program as PAN (Pan Asia Networking) in 2000.

12. Central, South and West Asia

The Internet came late to Central, South, and West (Middle East) Asia, but many interesting activities were reported lately.

SANOG (South Asia Network Operators Group)

SANOG was started in 2003 to bring together operators for educational as well as cooperation. SANOG provides a regional forum to discuss operational issues and technologies of interest to data operators in the South Asian Region, and meets twice a year. SANOG is the first regional Internet organization in South Asia with participants from Afghanistan, Bangladesh, Bhutan, India, Maldive, Nepal, Pakistan, and Sri Lanka. SANOG has very close cooperation with the rest of Asian Internet organizations including APNIC and APRICOT.

Silk Project

NATO's Silk Project is designed to develop national and regional research and education networks in Central Asia and the Caucasus, and it is officially called the Virtual Silk Highway. It also has satellite links to Europe. The project originated as a NATO-funded project in 2001, and included the following countries in Central Asia; Afghanistan, Kazakhstan, Kyrgyzstan, Tajikstan, Turkmenistan, and Uzbekistan. It also includes three countries of the Southern Caucasus: Armenia, Azerbaijan, and Georgia.

http://www.silkproject.org/

EUMEDconnect

The EUMEDconnect project is an initiative to establish and operate IP-based networks in the Mediterranean region, and the project started in 2001. The EUMEDconnect network serves the research and education communities of the Mediterranean region, and is linked to the pan-European GEANT network. Countries in West Asia (Middle East) which participate in EUMEDconnect Project include Egypt, Israel, Jordan, Lebanon, the Palestinian Authority, Syria, and Turkey.

13. Security

APNG started Security WG in early 1990s to coordinate security in the region as well as with other continents. Later, APNG Security WG supported creation of several security-related groups including Asia PKI Forum in 2001, and APCERT in 2002.

14. Internet Prolification

Internet Users

The Internet became very popular in Asia lately, and the Internet user population in Asia surpassed those of North America and Europe in 2000s. There are many other Internet areas where Asia is leading the world including broadband penetration, online games, and mobile Internet.

Broadband

Broadband proliferation started in late 1990s in Korea, first, followed by other East Asia countries and economies including Hong Kong, Taiwan, Japan and metropolitan areas of China. They are leading the Broadband penetration globally with many innovative applications. Broadband is rapidly becoming the social infrastructure in the region.

Online Games

Online games over the Internet is one of the applications where East Asian countries and economies are leading globally. This is partially due to the broadband proliferation. Many leading companies for online games reside in the region.

Mobile Internet

The mobile Internet based on cellular telephone became very popular in Asia, starting from i-mode in Japan in 1999, followed by countries and economies in East Asia including Hong Kong, Korea, and Taiwan. The mobile Internet is used for E-mail, web access, e-commerce and many other applications.

Many other innovative applications have been developed in Asia.

15. Concluding Remark

It has been 23 years since the first Internet was deployed in Asia, and 20 years since the first Internet-related conference with the coordination meeting was held in Asia. This short paper on the brief Internet history in Asia focused on the Internet-related organizations, mostly technical and business organizations. We need another paper on social, cultural, and political aspects of the Internet history, and hope some group will take on this challenge.

I appreciate AP* Retreat community, APNG community and others who contributed a review of this paper.

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How China was Connected to the International Computer Networks

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"Computer interconnection between Germany and China was realised on the basis of the following protocol architecture: X.25 was used for the lower three OSI layers, CSNET/PMDF protocol for the layer four transport protocol, and application-oriented protocols for the e-mail service of CSNET for the higher layers. In the implementation use was made of …." Though technically far more exact, of course, the majority of specialist articles about projects in the field of computer communications take this form – and there is certainly some justification for this. Nevertheless, much is missing from such publications as regards project implementation. Important details, basically even what is most crucial: people, ideas, motivation, linkup problems, wrong paths, chance, luck, misfortune, despondency, tension and finally pleasure once the goal is achieved. Perhaps the interconnection of computers between Germany and China is, not least because of the out-of-the-ordinary boundary constraints, a suitable case study to give an account for once of the other side of project reality, and this now follows.

The idea of setting up a computer link with China basically had its origins in 1983. At that time, the first WASCO symposium took place in Beijing at the invitation of Chinese users of

Siemens equipment. Eighteen speakers from various German universities, major research institutes, and industry gave outline lectures that summarised current and future trends in the most important areas of IT in the "far-off countries of the west." In parallel sessions they then got down to details, with the speakers answering questions even down to the bits-and-bytes level.

With the subject of my main talk, "DFN – German Research Network," I had set the main focus in the communications sphere. The accompanying tutorial lectures were largely devoted to the OSI architectural model, which was still unknown in that region at that time.

The period after returning to Germany from China was devoted to implementing the network projects presented. One was a milestone, the first connection to the American computer science network, CSNET, in mid 1984 from Karlsruhe. With this connection, which for the most part was implemented by Michael Rotert, we had made electronic mail service available for the first time, and were quickly convinced of its advantages.

With provision of the CSNET service both within and outside Karlsruhe University, there began a lively "mission activity," whose reputation also gave impulse to our colleagues in the direction of China. Anyone ever making contact or working in collaboration with China is aware of the long route and time delay for replies. A turnaround time of 14 days is even considered fast if one does not want to resort to the extortionately expensive telephone or telex, which are not available everywhere. When preparing for the second WASCO/ CASCO symposium for autumn 1985 the difficult communication often became a test of nerves on which the enterprise seemed to almost fail. Hence from a mixture of frustration, belief in progress and staying power, the obvious desire became ever stronger to have a computer connection with China.

This idea was set forth in the form of a letter on 16 July 1985 directed to "father of the people," Lothar Späth, former prime minister of Baden-Wurttemberg, whose involvements with China and zeal for decision making in the high-tech sphere are well known. A sum of money for a separate node computer of our own was mentioned – so that our link to America would not be affected – and a small amount for running costs. As partner, we had selected the Institute for Computer Applications (ICA) at the Technical University of Peking (today, University of Science and Technology, Beijing, www.ustb.edu.cn). I had in the meantime established a personal friendship with its former head, Prof. Y. Fung Wang (75 years old and still very active professionally). Its then current head, Director C. C. Li, was a guarantor for proficient and committed implementation.

Despite all the hectic preparations, the second WASCO/CASCO symposium ran according to program, with the subject of my main lecture "International Scientific Computer Networks" arousing even further interest in a computer linkup on the part of the Chinese delegates. Further lectures jointly with Hans Lackner about "Experience gained in building the Karlsruhe local informatics network - LINK," and also LAN technologies in general, propagated knowledge about the connection between WAN und LAN services.

Up until then, really nothing had yet happened except for the awakening of desires on the part of the Chinese, when suddenly, in autumn 1985, money for a project to link computers with China was delivered to the University of Karlsruhe, and the suspicion fell on me. In his farsightedness and kindness, Lothar Späth had actually responded to my letter and granted the money. Strictly speaking, he delegated the problem of procuring the money to the Ministry for Science and Art, which no doubt had to take it away from some other area. Regardless of how, the go-ahead had been given and it was our turn once more.

To start with, reservations were voiced by various parties as to whether we were perhaps doing something illegal in linking-up to China, which might damage our linkup to America. We calmed things down with our plan for a physically separate point-to-point connection. As a result, reservations were initially put-aside and we were able to continue untroubled.

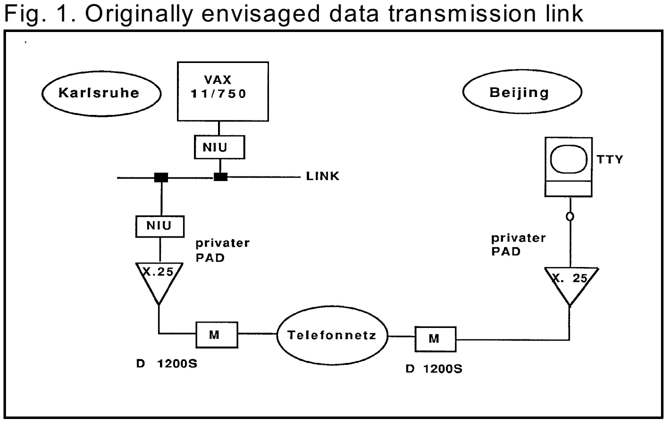
What was then needed though was to resolve the following points quite specifically:

1. Procurement of a German node computer
2. Procurement of a Chinese node computer, suited to this
3. Implementation of a secure data transmission link

Point one was quickly resolved: with the money obtained through Dr. Späth we bought a µVAX II, which was soon up and running under UNIX 4.2. The decision in favour of UNIX was taken because this was also available in China, and it allowed a linkup via UUCP without otherwise needing somebody's approval. Point two proved to be somewhat more difficult. Of course one also wanted to procure a VAX at the institute (ICA) but the procedure to apply for the necessary foreign currency (fec = foreign exchange currency instead of Yuans) is incredibly complicated, comparable perhaps to the law for funding university buildings in Germany, when circumstances are difficult. Moreover, a Chinese clone that would also run under UNIX was soon to be ready.

Once we could see no possibility of influencing point two from outside, we turned our attention to point three, the secure data transmission link. Since we knew of no data networks in China comparable to those of the DBP (German PTT), we resorted to the simplest method of implementation for us, i.e., a telephone dial-up connection with overlying separate X.25 PADs for security (see fig. 1).

Fig. 1. Originally envisaged data transmission link



No sooner said than done. The necessary equipment:

- . X.25 PAD (for China)
- . Line monitor
- . 1200 baud modem including a telephone

was procured and tested locally, with Mr. Wenzel providing us with friendly support on behalf of the Karlsruhe PTT.

In the course of a combined project and lecturing trip to Beijing and Shanghai from 15-27 May 1986 the connection was to be set up and tested. The procurement including dealing with all formalities for time-limited export (which are not without tricky variants) was completed in the minimal time of one week. I had barely one $^{3}/_{4}$ hours for the trip from Karlsruhe including check-in, and getting the equipment through customs including payment of excess baggage charges (an additional DM 2100 had to be paid). An overview of the rest of the expedition schedule follows:

14.-15.05.86 Outward flight
16.-19.05.86 ICA, Beijing
20.-23.05.86 Tongji-University, Shanghai
24.-27.05.86 ICA, Beijing
28.05.86 Return flight

To sum up: everything went well with the trip except for the planned linkup. We tested the telephone connection at all possible times of the day and night, finding speech communicability to be even entirely in order, but, on switching over to the modem, the "carrier" was always released again within a few seconds. The testing organisation of the German PTT in Frankfurt was enlisted and surprisingly confirmed sufficiently good quality with a bit error probability of 10^{-8} on the international pathway. However, one should not imagine the testing to be quite that simple because, firstly, outgoing calls from China at that time were still connected manually with waiting times of up to one hour and, secondly, the time difference of seven hours meant almost no overlap in the normal working hours of Germany and China, not to mention the telephone charges.

We broke off the tests on 19 May, whereby, with the support of the Chinese PTT, it was intended to undertake further trials after my return from Shanghai. A meeting was held on Monday 26 May with a PTT engineer, who proved to be amazingly knowledgeable, with the relevant CCITT standards (V/X) at his finger tips. He indicated that the cause of our problems was the poor line quality in the local area with bit-error probabilities of 10^{-3}. The only option for improvement would be a permanently connected line between ICA and the PTT's international exchange. This sounds much simpler than it is in reality since lines in Beijing were so rare. One indication of this is that usually an entire residential area had access to only a single phone line. Despite this, we decided to pursue this option in the weeks to follow and then set up the X.25 tests again.

Not long before our date of departure the PTT engineer said, "And incidentally – there is already an X.25 connection in Beijing. Several institutes have access to a PAD at the PTT, which is connected to Italy via a satellite link." I almost fell off my chair for, of course, this was exactly what we needed. The enquiry as to which of all the institutes in Beijing these would be, revealed that one happened to be right next door to the ICA. It was the NISTI (North Institute for Scientific & Technical Information) – 100 metres away – and a fortunate owner of a PAD access terminal, even with its own dedicated line. NISTI and ICA were not only neighbours but even belonged to the same department in the ministry, so it was plain sailing from there on.

An appointment was made to visit NISTI on the next day, Tuesday the 27 May, one day before departure. Unfortunately, the electricity was always turned off in this part of the city every Tuesday due to a shortage of energy, i.e., all computers are shut down and even the sockets no longer have any "juice." Fortunately though, to counter this injustice, the people at NISTI had constructed a small battery-based emergency supply for their PAD terminal, to be independent of the main supply. This then allowed the demonstration to take place. It worked trouble free as can be seen from the following excerpt from the dialogue script.

PAD Session Log

```
SIST - 10 MULTIPAD
 PKTELCOMB BEIJING, CHINA

* 3

* C 2222620021 ditchi0005es
com 2222620021/

network: password:
000000000000000

Please enter your ESA-QUEST password
rbc @@@@@

if you having difficulty logging on
Please contact IRS or your national centre
clr
*
```

Moreover, the entire operation ran quite fast. The connection setup times to Italy were around three seconds and most important of all the entire link setup including the satellite line was within the scope of an European Science Agency (ESA) project, which for the time being also covered the cost. I flew back reassured, with the remaining matters to be taken care of from Germany. IRA computing center business, lectures and other projects allowed China to slip somewhat into the background again, but after the holidays we got back down to it again.

The following needed to be done or ensured:

1. Discover the person responsible for the Italian project or the X.25 operating company
2. Support through the German PTT
3. Support through the Chinese PTT
4. Through connection and test in ICA/NISTI

It took three telephone calls to find out who was responsible for the Italian project. This was done via ESOC in Darmstadt, Germany, and on 20 August 1986 we were put through to the relevant specialist, Signore Buenoventura (in English: Good Future), at the firm of ITALCABLE. I explained what we wanted to do and he said that, in a quiet hour, he would like to try extending the X.25 administration for Germany, so that one would be able to be put through to DATEX-P via the country code 026245. Telephone calls to the Ministry of Telecoms in Bonn revealed that the latter were very interested in an X.25 link to China, although letters on this subject to the PTT in China had so far remained unanswered. I offered to set up informal contacts via ICA and enlisted Prof. Wang for this. Meanwhile, colleague Signore Buenoventura had registered the extension for DATEX-P in Italy and thought that we should try it out.

Of course at that time communication with ICA still went via telex and telephone, and we once again passed on the necessary commands to China in order to select on our PAD the local LINK network and ultimately our VAX. Meanwhile, we had set up a "Wang" mailbox, via which in the future all e-mail communication with the ICA was to be routed.

Using a line monitor in front of the PAD we traced the attempts to set up a connection from China and gave support. After several attempts the time had finally come on 26 August 1986; the first login on our VAX from China had been achieved and it wasn't long until the first e-mail was also sent. As chance would have it, shortly thereafter a delegation of our university's vice-chancellor was visiting Beijing, to whom we were able to send the first electronic message of greeting from Germany. Strictly speaking, of course, the message lay in a mailbox on our VAX computer, and was fetched from there by remote dialogue from China and printed out via a terminal printer at ICA.

Nevertheless, our mail arrived at the optimum point in time and generated much pleasure at both ends. With that, both the first X.25 link between Germany and China and a simple e-mail communication had worked. We announced the result to the public via a press release, which met with an extremely positive response since numerous other institutions such as:

Technical information centres

DIN (German Institute for Standardization)

Patent offices

were very interested in such access from China. By being able to have direct dialogue with Germany, the possibility arose for many projects, e.g., in the DIN area, of considerably simpler alternatives for data management and updating in China than was previously the case.

Whilst we reaped a good deal of publicity from this first partial result, it has to be admitted in all honesty that we alone did not do a great deal technically, rather the helpful colleagues at ITALCABLE set up the through connection. Our contribution actually lay in being fortunate enough to find and pave a way via the different entities involved, which ultimately also then worked. The German PTT acknowledged this in that it officially released this route on 1 December 1986 as a new service, with charges and all the other paraphernalia. It was even planned to replace the ESA project link via Italy with an official satellite link between Germany and China. In the meantime we rested somewhat on our laurels, had a modest e-mail communication with the ICA and were fully occupied with other matters. Nevertheless it was clear that the true project goal of interconnecting computers had of course not yet been accomplished, but merely a secure means found for data communication. Unclear, in particular, was how the host computer required in China for the linkup could be provided.

At this point a short report must be inserted about a further activity, which initially had nothing to do with the China project, namely the CSNET-MAIL BS2000 project.

Those who are familiar with Siemens DP systems will know that integrating BS2000 systems into national and international computer networks, and participation through this in electronic mail services, is not a simple matter. Siemens own X.400 development had only just been announced. KOMEX was partly very elaborate as a conferencing system. Porta-COM was sometimes not supported for BS2000 and the EARN interfaces exhibited functional limitations. For these reasons we decided in 1985 to start a CSNET/ BS2000 implementation, which shortly thereafter was elevated to a Siemens cooperation project. For the implementation task we had assigned a promising IT student named Michael Finken (21 years old at the time), who was to later play a key role in the China link-up project.

Michael did the implementation independently. Now and again urgent status messages of the form: "Now it has seized it!," "They are now chatting with one another" or "They are not checking it," forced their way through to me regarding the progress of the project, which reassured me every time. After working for about one year, the first version ran in autumn 1986 on our Siemens central computer, and the first versions were delivered after a further three-month internal test phase. Karlsruhe University administration, Univ. of Kaiserslautern and Univ. of Saarbrücken were the first CSNET pilot customers, together with whom various data communication links in particular were tested: X.25, dial-up connection, LAN-link and others. From early 1987, the node "unisb" ran stably on the Karlsruhe CSNET node and, in addition to further distribution, Michael devoted his time to improving the user interface as well as the documentation.

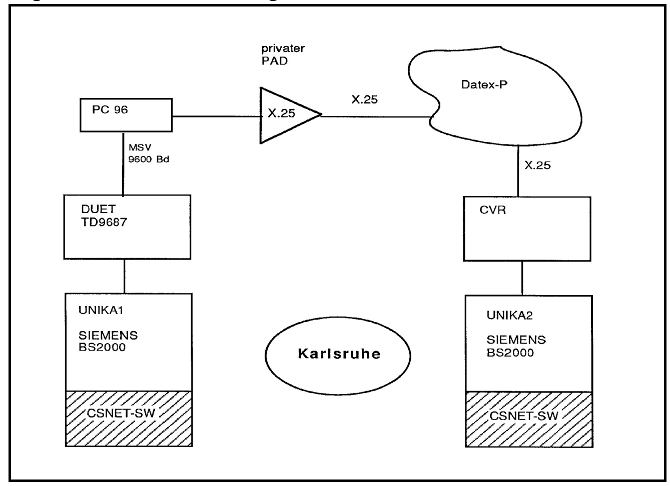
In parallel with this, preparations were already underway for the third CASCO symposium of 7-11 Sept. 1987 in Beijing. We were planning for the period from 1 to 25 Sept 1987 including visits to other universities at Chengdu and Wuhan. This time the Chinese side had designated computer networks as the most important topic of the conference, and I had the honour of delivering the opening lecture on the subject of "Computer networks – Current state and development trends."

As a replacement for Hans Lackner for support on the subject of networks, this time I had recruited Stephan Paulisch, one of the leading developers of our local area network, LINK. With the hectic pace of preparations for the lecture and conference, the computer interconnection with China project almost sank into oblivion, particularly since there was no news from the Chinese side on the matter of procuring a VAX. With the general count down though, we once again considered what we might still possibly do to advance the project. The idea arose of bringing our BS2000 implementation into play on this trip.

Of course we were once again faced with the tricky problem of deploying American technology in China. Michael reassured me by explaining that in the meantime he had reimplemented the major part of the CSNET software, so that very little remained of the original. But still on the 19 August, in the evening I enquired with Prof. Lawrence Landweber (network name “Larry”) at the University of Wisconsin, who within CSNET was responsible for the international partners as to what his view would be if we were to take our BS2000 version with us to Beijing for a test installation. I pointed out that undoubtedly several months would pass before a computer linkup could be expected. Larry’s view on this was totally positive and already by early morning on 20 August I had his OK both to take along our software and to attempt an experimental trial operation between Beijing and Karlsruhe! It even emerged immediately thereafter that even on the American side a pronounced interest existed in a computer linkup to China.

The matter was now imparted with some drive. Within 24 hours Michael was enlisted to accompany us on the trip to China if he wanted to (which he did). A project plan was drawn up. The Chinese partners were notified. A plane ticket was obtained, his passport sent to the Chinese embassy. A list of the required hardware and software components was drawn up. And the local test field for simulation of the Chinese environment in Karlsruhe was defined (Figure 2).

Fig. 2. Local test configuration to simulate the China link



With the support of Gerd Wacker, who later held a position in Karlsruhe, Michael Finken needed at least half a week to get the test configuration running. After that it seemed clear what it would need to look like but it was unclear what else we would still need locally:

Line monitor
PROM programmer
PASCAL compiler
Run-time system
Latest PDN version

and more besides.

We decided (mindful of the DM 2100, previously paid for excess baggage) to only take the most necessary items with us, i.e., the CSNET-BS2000 software and protocol converter PC96 each with two spare versions, in case something should go wrong during the flight or security checks. Everything was finally ready on the first of September and after a stopover in Bangkok we touched down in Beijing on Thursday 3 September.

On Friday 4 September the first journey after the welcome ceremony led us to the ICA. To begin with, we set up the X.25 link to Karlsruhe and reported our arrival in Beijing. After this Michael loaded the software, whereby it turned out that one of the tapes had in fact suffered damage.

The most important data is listed below in the form of a journal starting on 4 Sept. 1987:

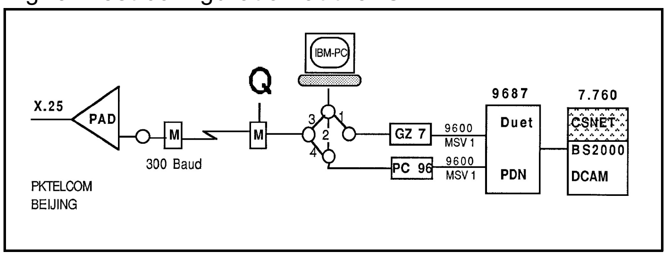
Friday, 4.9.

12.00 Installation CSNET software on Siemens 7.760 in the ICA.

Local CSNET mail ran!

After this initial success though, it took a further three tough weeks of day and night working (virtually round-the-clock) until the mail also ran via the computer linkup. For a better understanding of the subsequent trials please refer to Fig. 3 which explains the configuration used.

Fig: 3. Test configuration at the ICA



The four switch positions in the connecting field have the following meaning:

1. IBM PC is connected as a local terminal via the protocol converter PC96 (brought over from Germany) to a 9600-baud MSV1 line on the DUET (planned).
2. As under 1, but here the connection is via a Chinese GZ7 protocol converter (an ICA in-house development – worked already).
3. The IBM PC is connected to the PTT PAD and via this, e.g., in REMOTE DIALOGUE to one of the computer systems in the LINK (worked already).
4. The Siemens system is connected via the PC96 to the PTT PAD in Beijing and via this by computer linkup to the Siemens-HOST in Karlsruhe (planned).

We tested the various connection variants and found to our shock that the PTT PAD required a speed transformation from 9600-baud to 300-baud, whilst our PC 96 was generated at both ends with 9600-baud. Although we did ask for the essential technical data by sending a further mail to the ICA before our departure, that message remained laying unread in Karlsruhe.

It now felt like we were wandering in the desert with sufficient food but no can-opener; you see the PC96's software is stored in EPROM but of course we had neither the sources nor a PROM programmer with us, and unfortunately the PC96 did not have a DIP switch for baud rate settings. What could we do?

The problem of not having a PROM programmer was quickly resolved since the ICA (which incidentally is also very well equipped in other things), had one, and furthermore the correct one. First a patch had to be made to modify the speed to 300-baud. We sent the problem by mail to Karlsruhe and in the meantime turned to the working connection 2 to the Chinese protocol converter.

Friday, 4.9.

16.00 Attempt to output an e-mail on the IBM PC
Result: DCAM-ERROR!!

The cause was quickly isolated: the ICA is still running BS2000 version 7.1 and a corresponding old version of DCM, whereas our software runs on 7.5 and was developed under DCM version 8. Therefore, recompile! For this though, the source modules for the assembler routines, which implement the access to DCAM, need to be fetched from a library, which in turn was created with FMS (BS2000 File Management System).

But the ICA does not have FMS. Where in Beijing could FMS be got hold of? Idea: the Siemens branch office must in fact have it. Phone call to Siemens. Bernd Grüther agreed to provide support, with the technician to bring it along on Monday. That's as far as we can go – for the moment.

Friday, 4.9.

Evening: Welcoming of the delegation in the People's Hall by Minister Zhao Jia Hua, (who even mentioned our project personally).

Saturday, 5.9. Visit to the Great Wall

Sunday, 6.9. Visit to the Mao Mausoleum, meet-up with the interpreters for the purposes of discussing the lectures.

Monday, 7.9.

9.00 Opening of the 3rd CASCO symposium. Main lecture "Computer networks – Current state and development trends."

16.00-17.00 Attempt to reach Siemens by telephone

17.15 Siemens has FMS

18.00-19.00 Fetch and load FMS
Message: EDT failed!!
Remedy: Build an EDT dummy and insert underneath.

20.00 Recompilation: CSNET run-time system OK. Output of text on IBM PC via GZ7.

Text appears on the screen, entries from the IBM-PC though do not arrive!
Recollection: PC96 is generated in the PDN with a different terminal type than GZ7. Mail software is adjusted to the PC96. Consequently, the first 15 characters are discarded when inputting.
Problem: To change this, the CSNET software would need to be recompiled with PASCAL. ICA however does not have a PASCAL compiler!
Idea: Patch the object module by overwriting the "15".

Patching the object code is easier said than done. The CSNET software is several 100-Kbytes long and contains a lot of binary code "15". However this was the only option in this situation. We set about it and after 20 minutes had the correct "15". Using PAM a "3" was overlaid and a new attempt started.

Monday, 7.9.

21.00 Text entered arrives correctly.
Next problem: on outputting, an unwanted "@" is appended as the station-specific message header.

To suppress the @ we again had to delve into the binary code. This time it was more complicated because the Pascal compiler's optimisation had been applied at this point. The length of the message header "@" was exactly ONE, a value that the Pascal run-time system always keeps in a register. Consequently, at this point the content of a register was written to memory instead of the constant 1. Pondering, poring over the machine description … then the idea; search back through the code to see whether a register is loaded with 0, and then swap the register numbers in the corresponding command. We are in luck and find such a register 10 commands further on.

Monday, 7.9.

22.00 New trial: Input works, REP is ok.
New problem: It does not go any further. The mail protocol is stuck!

23.00 Action taken: We insert a LINE MONITOR in the line and observe an incredible amount of TRAFFIC between GZ7 and DUET.

24.00 Assumption: V.24 problem???
Idea: Check the signals. (A Chinese colleague comments with a glance at the clock: "The Germans are impossible"). We want to continue but somehow the right cable for the tester is missing and we decide to break off and resume again the following morning.

The problem at midnight was simply that once again the ICA is without power on Tuesdays. Although director Li had already got in touch with the municipal works department to obtain special treatment in our case, this was by no means guaranteed.

Tuesday, 8.9.

9.00-17.00 Lectures, separate parallel session on "E-mail and other services in local area networks," demonstration of local mail.

17.30 Testing of V.24 signals with and without a null-modem, V.24 is OK.

20.45 Cause of the incredible TRAFFIC found: The GZ7 protocol converter's transmission also includes the TRANSDATA HEADER which upsets the NET/ONE in Karlsruhe.

21.30 Message from Karlsruhe: to set a speed of 300-baud, the contents of address hex "349" must be changed from 0C to 5C.
At last!!

22.30 Finish for the day because the change cannot be made until the following Monday.

On Wednesday a project meeting was held with vice-president Yang, where, upon our recommendation, it was at last decided that the Chinese side should for the first time attend the International Academic Networkshop in Princeton, N.J. on 9 and 10 November 1987, and also hold a networking conference in spring 1988 in Beijing. Invitations to this should include Prof. Landweber, University of Wisconsin, Prof. Farber, University of Delaware (both CSNET) and Dr. Dennis Jennings, University College Dublin (EARN). Immediately after the meeting I sent off the appropriate invitations by mail.

Wednesday, 9.9.

Morning: ICA burns-in a new PROM for PC96

Afternoon: PC96 is connected.
Does not run!!!
Symptom: PC96 is not polled by

DUET, whereas GZ7 operates perfectly.
<u>Ideas:</u> Check the PDN generation, V.24 signals synchronous/asynchronous, check buffer 9603 hardware-wise.

By reference to the hardware manuals, the head of the ICA team, Mrs. Qiu, determines that the DUET requires a correction in the WIRE WRAP on pin 83, which supplies the clock pulse for asynchronous buffers. She promises the change will be made by the following morning.

Thursday, 10.9.

8.30-11.00 PC96 is still not running, although the WIRE WRAP and V.24 are OK. We are being slowly driven to despair. Neither does OSI help things along. We just don't know on which ISO layer the error might be hidden!

11.00 Power failure, ICA switches over to the emergency supply (UPS) with which the 7.760 runs for about a further ten minutes.

13.00 DUET runs STAND ALONE until an UPS alarm emphatically demands a total shutdown.
<u>Idea:</u> Have the 9603 buffer checked by Siemens. Call to Siemens. Technicians are there but have a huge workload, we should go there and explain the problem.

17.00 Trip into the CITIC building to Siemens. Messrs. Fleischmann and Schneider are both extremely familiar with the buffers. We persuade Mr. Schneider to come with us to the ICA and take a look immediately thereafter.

18.00 Nobody is in the ICA and the power is off because a reception is taking place in the Friendship Hotel. On top of that, our own one. We give up!

Friday, 11.9.

8.30-11.00 Concluding lectures, ending of the conference, Mr. Fleischmann from Siemens is meanwhile testing the buffer (with all tricks), repairs the timing, generates the PDN anew. Line is polled. At last!

12.00 Messages from Wisconsin, Delaware and Dublin. Prof. Landweber, Prof. Farber and Dennis Jennings all accept for spring 1988. Great!

13.45 PC96 runs!! Data can be input via the IBM PC and the CSNET script simulated. Wow!

14.00 We plug together the cables between China (DUET) and Germany (PTT PAD) for the first time (connection option no. 4 – see Fig. 3 above) and wait for the PAD message: "WELCOME IN BEIJING." Nothing, instead we get ERROR!

14.00-18.00 We check out all of the options (see Fig. 3): - IBM PC via PC96 to Siemens runs (1) - IBM PC via PAD with Karlsruhe runs (3) -Siemens with PAD via PC96 returns ERROR (4)
LINE MONITOR shows: PC96 generates in direction DUET a string of ???
Mail query in Karlsruhe: when can that happen?
Laconic reply: if PC96 receives invalid characters.
In the middle of our work we are obliged to break the work off in order to participate at a Siemens reception in the Park Restaurant.

22.00 Return to the ICA. The team in Karlsruhe, comprising Michael Rotert and Gerd Wacker, is on line, which allows us to hold a direct terminal-to-terminal dialogue.
Back to the ???-Problem: possible reasons are poor signals and PARITY errors.
<u>Idea:</u> PARITY definition between PC96/ Siemens and PTT PAD is incorrect.
<u>Test:</u> We alter the PARITY on the IBM PC and the PC96 actually generates the ??? Great!

3.00 Now we want to know from Karlsruhe how one alters the PARITY parameter in PC96; the same problem as with the 300-baud, except that until Sunday afternoon we only have one and ½ days left before our flight leaves. The Karlsruhe team doesn't know either where patching is to be done. Perhaps Hans Lackner, sitting at home unsuspectingly having his tea, will know the answer. We speak imploringly and with all our powers of persuasion that he should be called in, when finally the message arrives; he is on his way and seeking the location.

In the meantime we are trying to find out the PKTELCOM PAD parameter for PARITY. It also answers nicely to the param command with a column of numbers of 15 x 2 values, but who keeps them individually in their head? Fortunately, the ICA still has a copy of the MICOM PAD manual that I brought over the previous year. We check the parameters and set the relevant ones to HOST-HOST communication. We send the lot through to Karlsruhe again, who also believe the parameters must be OK.

Hard luck in this was just that; the critical PAD parameters that define the PARITY bits (7/8 EVEN/ODD/NO) lie from 101 upwards and are not standardised internationally. For that reason we really ought not have been angry with the PKTELCOM PAD since it ignored our 101 parameter entries, which it was fully entitled to do. Nevertheless, we were angry and decided to complain or make enquiries the following morning at the Beijing PTT.

4.00 Message from Karlsruhe: the PATCH is there, we are to alter cell 'X348' from "FA" to "CA" or "EA". Eureka!! Feelings of extreme gratitude emerge.
We enquire further as to what the individual bits signify and are sent a partial list of assignments.

4.30 The Karlsruhe team is now applying pressure; we are to insert the patch and test. But now we were slowly beginning to show effect and in doing so made an interesting observation; in the computer centre at 5 o'clock in the morning the skin colour of Europeans and Chinese becomes increasingly similar and meets up in a pale shade of green. All those involved were also of the same frame of mind and we explained to the Karlsruhe team at the other end of the line that we simply could not do anymore and would continue in the morning.

Saturday, 12.9.

11.00 Again in the ICA, Mrs. Qiu and the others had indeed tried again during the night to alter the PROM, but the PROM programmer was faulty.

12.00 Director Li decides to buy a new one and sends an employee to the nearest computer store with a cheque (which incidentally would not be that simple at a German university)!

13.00 We meanwhile place bets as to the PARITY setting that will make it work. In the ICA we find the INTEL manual, which gives an exact description of the control words for the I/O module in the PC96.

14.00 Patched PROMs ready, installation, tests, result: ??? ... as previously.
We are ready to freak out.

18.00 Systematic checking through all combinations of PARITY – nothing! Even now ??? ...

18.00-22.00 Evening meal and discussion of the situation with Prof. Wang. The others think we should break off and quietly give the matter some thought in Germany and then start up again in October or November. I say that we want to find out now and make a final attempt at it this very evening.

22.00 Execution of a series of tests to determine whether the ??? ... problem is determinate or indeterminate.
Selection of all possible combinations of PAD and IBM PC parameters.
<u>Result:</u> Problem appears to be deterministic.

2.00 Everything stops working, even the local connection of the IBM PC to the Siemens no longer works.

2.30 An absolute low point!
Recollection of yin and yang (see Fig. 4).

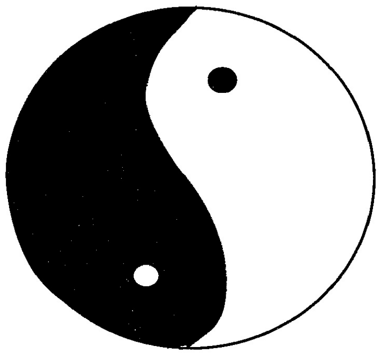


Fig. 4. Yin and Yang

Yü Hiung spoke: “The cycle is never ending. Who though notices the hidden changes of the heaven and earth? For when things get less on one side they increase on the other, when they become full here they reduce there.”

“Decrease and increase, completion and reduction are constantly being generated and ceasing, their arrival and departure are linked to one another by invisible transitions. Who indeed notices? Everywhere a force does not suddenly increase, a shape does not suddenly reduce, which is why one does not notice their completion or decline. It is the same as with people, who from birth until old age change daily in external appearance and in the level of their knowledge; skin, nails and hair are continuously being generated and fall off. Nothing remains stationary at the level of childhood without change. The transitions are imperceptible; one only notices them afterwards. Yin and yang gave us the certainty that, after a low point, things could only get better and this was the case.”

Waiting for correct characters from Karlsruhe.

2.35 Stephan Paulisch had the idea of trying to set up the connection to Karlsruhe manually, i.e., using the IBM PC to set up the connection to the Siemens in Karlsruhe and to then manually replug to the Siemens in the ICA. We decide to make this last attempt and, in fact:

2.45 The first correct characters arrive from Karlsruhe!!! Hooray!!
The reason: both Siemens systems work with the same character representation, whereby the PAD parameters are set such from the Karlsruhe side that the characters pass through correctly.

3.00 Discussion of the situation and assessment; with the improvised solution of manual connection setup via the IBM PC it is possible to test the CSNET link as regards software.

5.00 Individual discussion in the Friendship Hotel

I take Michael Finken to one side to ask him whether he could not stay on in Beijing alone to complete the work, for the rest concerned primarily his software. Good-natured and motivated as he was, he also agreed straight away! To be fair, it should be said that in Germany I had already prepared him for this possibility. Nevertheless, I think highly of him for his spontaneous agreement because, after all, he had let himself in for a solo adventure and sacrificed the no doubt delightful Yangtze river trip, which had already been booked for him and paid for.

Sunday, 13.9.

11.00 Closing discussion in the ICA
Announcement: Michael Finken is to stay on until things are running! Our ICA friends are very happy for they were just as committed to success as we were.
Optimistic as we were, we set up a greeting message to be sent all over the world in the event that the system worked. “Across the Great Wall we can reach all corners of the world” (see Fig. 6).

Fig. 6. First Electronic Mail from China 20 Sept. 1987 (the messages to Zorn and Finken were sent to provide copies in their German mail boxes).

```
Received: from Peking by unika1; Sun, 20 Sep 87
16:55 (MET dst)
Date: Mon, 14 Sep 87 21:07 China Time
From: Mail Administration for China <MAIL@ze1>
To: Zorn@germany, Rotert@germany, Wacker@germany,
Finken@unika1
CC: lhl@parmesan.wisc.edu, farber@udel.edu,
jennings%irlean.bitnet@germany,
cic%relay.cs.net@germany, Wang@ze1, RZLI@ze1
Subject: First Electronic Mail from China to
Germany

 "Ueber die Grosse Mauer erreichen wir alle Ecken
der Welt "
 "Across the Great Wall we can reach every corner
in the world "

Dies ist die erste ELECTRONIC MAIL, die von China
aus ueber Rechnerkopplung in die internationalen
Wissenschaft snetze geschickt wird.

This is the first ELECTRONIC MAIL supposed to be
sent from China into the international scientific
networks via computer interconnection between
Beijing and Karlsruhe, West Germany (using
CSNET/PMDF BS2000 Version).
University of Karlsruhe  Institute for Computer
- Informatik              Application of State
```

Rechnerabteilung - (IRA)	Commission of Machine Industry (ICA)
Prof. Dr. Werner Zorn	Prof. Wang Yuen Fung
Michael Finken	Dr. Li Cheng Chiung
Stephan Paulisch	Qui Lei Nan
Michael Rotert	Ruan Ren Cheng
Gerhard Wacker	Wei Bao Xian
Hans Lackner	Zhu Jiang

Further mail to Michael Rotert and Gerd Wacker in Karlsruhe, who authorised this, to do everything conceivably necessary to give optimum support to Michael Finken in Beijing.

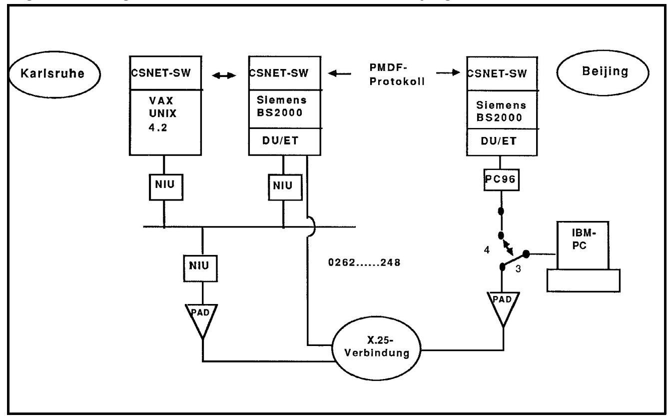
14.00 Departure from the Friendship Hotel

16.00 Departing flight to Chengdu, in Sichuan province

I picked up the further continuation of the work by telephone when traveling (which in some cases was not very easy), which means that I too can now only report by "View from the wall:" – to resolve the tiresome ??? problem called for a further patch in the PC96, which Roland Stoffel quietly discovered and passed on to Beijing.

The solution to a further fundamental problem though was still to come; the CSNET mailers were hung in DEADLOCK!!! The reason: an error in the PMDF standard protocol. This error was later reported to the CIC (CSNET Information Centre) and confirmed by them. Many years previously this problem had occurred when telephone connections were very bad, but had not been rectified at the time, and, because line quality had improved, the problem had cleared itself.

Fig. 5. Configuration of CSNET nodes in Beijing and Karlsruhe



In our case nothing cleared up just by itself, which meant Michael Finken (in Beijing) working together with Gerd Wacker (in Karlsruhe) was obliged to develop and implement a special protocol extension that dealt reliably with further error cases. This called for a further week of hard day-and-night work, with the hindrance of power outages and still the lack of a PASCAL compiler. On top of this, there was the time difference and the fact that the foreign language institute in which Michael was staying, locked up at midnight, which meant he sometimes had to kip down in the ICA (on a bamboo mat). Finally though, the moment had at last arrived.

Sunday, 20.9.

23.55 The prepared first mail is transferred correctly to Karlsruhe and from there to further networks.
The good news reached me in Macao, where we drafted a press release the same evening. This was telexed to director Li and from there and disseminated throughout the world via the official

Chinese news agency, Xinhua (See Fig. 7).

Fig. 7. Press release in the *China Daily* of 25 Sept. 1987

"Computer links are developed"

"China can now have computer links with more than 10,000 scientific research institutes, universities and computer manufacturers around the world.

The link using two Siemens computers in Beijing and Karlsruhe, Federal Republic of Germany, went into operation recently.

Prof. Wang Yunfeng, advisor on electronics information and technology for the State Science and Technology Commission, described the development as a technical breakthrough concerning the integration of China's universities and research institutes with the worldwide computer network. The link, he said, was successfully established by an expert team under the direction of Professor Werner Zorn of the University of Karlsruhe. The team included scientists from the Beijing Institute for Computer application, the University of Karlsruhe, Siemens, and CSNET of the United States" (Xinhua).

The remaining time, until departure on 25 Sept. for Hong Kong and from there back to Germany with the entire group, was utilised by Michael to stabilise the software, install the administration and set up mail accounts, create the documentation and give instruction to the operating staff at ICA.

Friday, 25.9.

11.00 Arrival of Michael in Hong Kong with the *China Daily* of the same day (which is never available in Hong Kong until the next day) and our press release.

20.00 Return flight to Germany with the delegation

Despite the joy of a successful mission, after our return the worrying question was whether the link would continue to work without our local support. We monitored our X.25 inputs continuously: nothing! Then finally on October 8 the ICA node signed on again, whereby in hindsight there was a simple explanation for the broadcasting silence.

October 1 is a national holiday in China, which many Chinese use to take a well-earned short break and this included our friends at the ICA. After their return the link continued to work without any problems and subsequently rendered useful services, including finding a solution to further problems still quite unresolved:

1. Official American agreement to the linkup with China.
2. Participation of China in the International Academic Networkshop in Princeton (9,10 Nov 1987) with admission into the networking community.
3. Propagation of services inside and outside of China with the goal of building China's own internal computer network.

As is known, we had received merely the OK from CSNET for an experimental test link but not yet the final approval. However, on account of the technical status now achieved, Dave Farber and Larry Landweber immediately put every effort into obtaining official agreement on the part of the American NSF (National Science Foundation) responsible for this.

It was a fine prelude to the Princeton meeting that Prof. Farber (CSNET) was able to hand over the official NSF letter of approval to vice-president Yang, head of the three-man Chinese delegation (see Fig. 8).

Fig. 8. Text of the official NSF letter of approval

NATIONAL SCIENCE FOUNDATION

WASHINGTON, D.C. 20550

Division of Networking and Communications Research and Infrastructure

Professor David Farber, Chairman CSNET Executive Committee	Mr. Ira Fuchs, Chairman BITNET Executive Committee

Gentlemen:

The extension of BITNET and CSNET electronic mail to China is a natural enlargement of the telephone and postal services that will increase the possibilities for collaboration among U.S. and Chinese research scientists. I welcome this move witch your organization has made.

Sincerely,

<signature>
Stephen S. Wolff
Division Director
November 8, 1987

Thus, approval is given not just for our CSNET link but equally for further planned linkups with China within BITNET.

In response to the press release sent right around the world, we learned that other groups were also working intensely to achieve a network link with China.

A project under the overall control of George Kemper and Jaan Laane of the Texas A & M University was running with the working title; **CHINANET - BITNET** to connect 17 Chinese universities to BITNET with a planned start of operation for the Transpacific link of 1 Oct. 1987!

The Chinanet project group immediately started a computer search by e-mail for a professor "Tso-en," who is said to have achieved the linkup using a "Xi men Xi" computer, and soon made a find. Since then there has been increasingly flourishing communication with many interesting and interested partners, which proves once again that computer networks do not alienate the people of the world but bring them closer to one another.

This article is a translation of the original publication: Zorn, Werner: *"Wie China mit den internationalen Rechnernetzen verbunden wurde"* in "PIK-Praxis der Informationsverarbeitung und Kommunikation." 11 Jahrgang 1988, Heft 1, S. 22–29 http://www-ks.hpi.uni-potsdam.de/index.php?id=36

Annex:

1988 Start of CANET

28.-30.03.1988 CANET- Chinese Academic Network launched at ICA/Beijing in presence of Daniel Karrenberg (RIPE), Dr. Dennis Jennings (EARN) and Prof. Werner Zorn (Karlsruhe University)

1990 Registration of .CN Domain

9.10. Prof. Yunfeng Wang (ICA/Beijing) meets Prof. Zorn at Karlsruhe University in Germany. They discuss further possibilities to support networking in China in general and CANET particularly. (E-mail – Prof. Zorn to Qian Tian Bai)

18.10. Prof. Zorn sends a pre request for "CN" to the Internet NIC (cc E-mail – Prof. Zorn to Qian Tian Bai on Oct. 24).

03.11. CANET/ICA highly welcomes this initiative and asks for technical support during the migration phase toward DNS (E-mail – Qian Tian Bai to Prof. Zorn).

26.11. Prof. Zorn officially applies for registration of the Chinese Top Level Domain CN at the Internet NIC. Primary Domain Name Server for CN is: **IRAUN1.IRA.UKA.DE** International Secondary Domain Servers for CN are: **MCSUN.EU.NET** and **UUNET.EE.NET** (E-mail – Prof. Zorn to Qian Tian Bai on Dec. 02, as well as the E-mail answer from Qian Tian Bai to Prof. Zorn on Dec. 03).

2.12. First usage of the newly registered : **TLD "CN"** (E-mail – Arnold Nipper/ Xlink to Prof. Zorn on Dec. 03).

1991

03.01. – 19.01.: Prof. Zorn sends an expert team from Karlsruhe University to ICA/ Beijing, consisting of Michael Rotert, Gerd Wacker and Nikolaus von der Lancken. Rotert implements the local DNS service together with the newest CSNET/PMDF-software on the VAX at ICA, Wacker and von der Lancken install LAN-components and the Dial-In Server.

01/1991- 05/1994

Karlsruhe University runs the CN Primary DNS until this service was taken over completely by the Chinese side (CNNIC), thanks to a direct link between China and the USA, which allows the provision of full Internet services.

(The emails are all still available from Prof. Zorn).

Netizens and Protecting the Public Interest in the Development and Management of the Internet: An Economist's Perspective[1]

by Anders Ekeland, NIFU STEP
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Introduction

This article will discuss some aspects of Internet governance with a focus on the role that "economic theory" plays in this discussion with respective to the roles of markets, government and civil society. The fundamental question is of course what is the most important aspect of the Internet. In my opinion it is the free exchange of information and opinions. This is a common good and a public good. The commercial use of the Internet is of secondary importance from an Internet governance point of view. This is not the dominant point of view among economists. But there is no such thing as "economic theory" in the singular. There are neoclassical, evolutionary, institutional, post-Keynesian theories, just to mention a few. None of these theories, and in particular the policies they recommend, are neutral, objective, built on a purely scientific basis. No social-science theory can be value-free.

This article is divided into two parts. In the first part, I argue that the major result from neoclassical theory that unregulated markets produced the social optimum. is not based on solid scientific evidence. In the second part, I illustrate that as soon as one does not take the "Pareto optimality" of unregulated markets as a fact, when in fact it is a dogma, quit a new look is needed on most questions of Internet governance.

Throughout the article I define "mainstream" as economic theory that uses "perfect competition" as its benchmark for the optimal, "first best" state of markets. I argue at length that the "results" from this paradigm are very strong in a normative sense and very weak in a scientific sense. The fundamental reason being that the "general equilibrium" is not only built on extremely unrealistic conditions, but it is not a stable equilibrium and – as argued by, among many other Nobel laureates, Haavelmo and Stiglitz – the "results" are not robust and consequently cannot be the basis for policy formulation regarding the role of government and the role of markets. Further, my argument is that mainstream economics is – due to the static nature of the theory – far too narrow in its analysis of Internet governance. First of all, it does not discuss the justice, the legitimacy of the "initial endowments," i.e., the initial distribution of power and/or property rights. Secondly when it comes to the actual governance of the Internet, the DNS system, the mainstream economists believe in using markets – there is no room for democratic, deliberative mechanisms in their models. This is in contradiction to the origin of the Internet when a rather small circle of scientists "ruled the root." Since 1998 the U.S. government through the Department of Commerce and the DOC through ICANN has been governing the key infrastructure of the Internet.

The belief in markets raises several important questions. Not the least the fact that markets take into account only needs backed by money. What about those whose legitimate needs are not backed by (enough) money? But even on the condition that we shall leave certain parts of Internet governance to markets, do markets actually work – even roughly – as the model of perfect markets predict? If not, how do we regulate markets in order to make them serve the public interest? For example is it completely logical from a neoclassical perspective to create and encourage competition among different Internets, different DNS systems in order to reap the benefits of competition? But it is necessary to ask: what is the dynamic of such competition – and who will it benefit? Is the public interest served by several competing Internets?

There is not "economic theory" in the singular

If you go to an ordinary mainstream economist conference you will invariably hear the

[1] This paper takes as its starting point my presentation with the same title at the conference "Past, Present and Future of Research in the Information Society," one of the official side events to the World Summit on Information Society in Tunis, Nov. 13th–15th, 2005, but is an enlarged and extended version.

speakers use phrases like "what does economic theory tell us about this" or "according to economic theory" as if there were some basic set of uncontroversial theories that every sane economist builds his work upon, like in physics. Using Google, I found 10,400 instances of the phrase "economic theory tells us," but only four of "*neoclassical* economic theory tell us" But there are of course several, very different economic paradigms "out there." Beside the dominating neoclassical, there are Austrian, evolutionary, Schumpeterian, institutional, post-Keynesian and Marxian theories.[2] Each of them is a broad church containing important different current. None of these theories, and in particular the policies they recommend, are neutral, objective, purely scientific. No social-science theory can be value-free.[3] The existing economic theories can be divided into two camps, often labeled by economists themselves as the orthodox and heterodox schools of economic thought. The fundamental dividing issue being the belief that the state of the economy described by "perfect competition" is the most desirable. The fact that there is fundamentally different schools of thought in economics is obvious. The fact that most neoclassical economists disregard this fact is in my opinion, just one more indication of the weak scientific character of the neoclassical paradigm. It is therefore no big surprise that Karl M. Manheim and Lawrence B. Solum in a high quality, well-written research paper titled "An Economic Analysis of Domain Name Policy" consequently write as if there is only one "economics," "economic analysis."[4] In one place they write "from the standpoint of neoclassical economics" only to conclude that "… if root service is a 'private good', then well established and uncontroversial economic theory suggests that it can best be provided by markets" (page 355).

That neoclassical economics is well established is a fact, but it is just as much a fact that neoclassical theory is *controversial*. It always has been, and is non the less controversial today. One indication is the title of J. E. Stiglitz Nobel Prize lecture: "Information and the Change of Paradigm in Economics." To call a theory uncontroversial when a Nobel Prize laureate argues for a change of a paradigm is clearly not scientific method at its best. In the concluding remarks of his Nobel Prize lecture Stiglitz writes:

> In this talk I have traced the replacement of one paradigm with another. The deficiencies in the neoclassical paradigm – both the prediction which seemed counter to what was observed, some so glaring that one hardly needed refined econometric testing, and the phenomena that was left unexplained – made it inevitable that it was simply a matter of time before it became challenged. One might ask, how can we explain the persistence of the paradigm for so long? Partly, it must be because, in spite of its deficiencies, it did provide insights into many economic phenomena. […] But one cannot ignore the possibility that the survival of the paradigm was partly because the belief in that paradigm, and the policy prescriptions, has served certain interests. (Stiglitz 2002)

I will return to the question of whose interest the belief in the paradigm and especially its policy prescriptions have served – and are serving. But first it is necessary to discuss the theoretical structure of the neoclassical paradigm in order to argue that the general policy prescriptions are not something that is "proven," neither theoretically nor empirically.

On the nature of the neoclassical paradigm

It is of course beyond the scope of this article to discuss all aspects of the neoclassical paradigm. My aim here is to summarize in a non mathematical way the well-known fundamental weaknesses of this paradigm so that a discussion of Internet governance can start without dogmas. I use well-known economists, two of them Nobel Laureates, in order to substantiate the proposition that there is no "rough consensus" regarding the way markets work, and consequently the division between government and markets.

[2] One recent example of this breadth of heterodox economics is the special issue of Cambridge Journal of Economics, "On the economics of the future," Vol. 29, No 6, 2005, herafter CJE-Future

[3] See for example, E. Tsakalatos, "Homo economicus and the reconstruction of political economy: six thesis on the role of values in economics," CJE-Future

[4] Manheim and Solum (2004, page 344 ff)

The two meanings of the word competition

A continuous source of confusion in the economics literature and in the public discourse about economic policy is the fact that the neoclassical concept of perfect competition is used in fact is confused, with the commonsense concept of competition. This problem was spelled out clearly by one of the founders of modern game theory, Oscar Morgenstern. In his article "Thirteen Critical Points in Contemporary Economic Theory: An Interpretation" he pointed out the two totally different meanings of the word competition:

> Consider 'competition': the common sense meaning is one of a struggle with others, of fight, of attempting to get ahead, or at least to hold one's place. It suffices to consult any dictionary of *any* language to find that it describes rivalry, fight, struggle, etc. Why this word should be used in economic theory in a way that contradicts ordinary language is difficult to see. No reasonable case can be made for this absurd usage which may confuse and must repel any intelligent novice. In current equilibrium theory there is nothing of this true kind of competition: there are only individuals, firms or consumers, each firm and consumer *insignificantly* small and having *no influence* whatsoever upon the existing conditions of the market (rather mysteriously formed by tatônnement) and therefore solely concerned with maximizing *sure* utility of profit – the latter being exactly zero. The contrast with reality is striking: the time has come for economic theory to turn around and 'face the music.' (Morgenstern (1972), page 1164).

The fact that "perfect competition" excludes changes in prices, technologies, tastes and initial endowments[5] cannot fit the rapid changing reality of Internet development and the ICT industry at all. To use a static model for anlysing rapid change in technology, price-setting behaviour, the growth of small garage firms to dominant, strategic players in the market, demands some really good arguments. To argue that the model of perfect competition shows the "final state," the final equilibrium is of very little help. Change has been going on for decades, and will most probably go on for quite a number of decades to come. One really has a difficult job to reconcile a theory whose basic results depend on static equilibrium with one of the areas in society that has been marked by the most dynamic development. This leads to the fundamental question, which is also the title of an article by a Nobel Laureate in Economics, the Norwegian Trygve Haavelmo.

What can the static equilibrium models tell us?

There is a widespread feeling that economists are much too abstract, too mathematical. I want to emphasize, although correct, that is in a way a superficial criticism. It mistakes the symptoms for the cause. The founders of the theory, Jevons, Menger and Walras did not want it to be utterly divorced from reality, but the conditions under which one can prove that "markets are best" just turned out to be extreme. Step by step from the late nineteenth century to the Arrow-Debreu finalization in the fifties, every piece of realism had to be weeded out of the theory. If the theory was just too abstract, too mathematical, the answer to such a critique would be to make the theory more complex – as is always the case when any theory becomes more realistic and consequently less abstract - in economics as in engineering. Our critique is more fundamental. In our opinion the static Arrow-Debreu model is mathematically consistent, but it is utterly divorced from dynamic reality – and must be so to serve its political function. The fact that it is divorced from reality has been pointed out by economists, like Kornay (1971), Kaldor (1971), Metcalfe (1995) Stiglitz (1995, 2003) just to mention a few. One of the most accessible analyses for the non mathematical reader of the deep problem with the static nature of "perfect competition" is the above-mentioned article "What can the static equilibrium models tell us?" by Trygve Haavelmo. First published in Norwegian in 1958, at the same time as Gerard Debreu (1959) published his seminally "A Theory of Value." The article was published in English translation in

[5] "Initial endowments" is economist speak for wealth, income and fortunes.

Economic Inquiry. Haavelmo's starting point is to …

> discuss how fantastically complicated the argument that price and quantity are determined by the scissors [market cross] really is, even if one accepts the most hard-boiled assumptions about market behaviour. […] In its naked simplicity, the well-worn picture of the intersecting curves is still the most important – and perhaps the only – rational foundation that one has to stand on if one wants to believe in the automatism of the free market.

Haavelmo then repeats for sake of argument the textbook logic behind the supply and demand curve and goes on:

> What is then so wrong with the proposition that the 'price will be where the curves intersect each other'? Only this: there is of course, not an iota of information in our behaviour scheme for buyers and sellers about how they themselves would 'find the market price.' Suppose we let buyers and sellers loose on each other under the presumption that a given market price will rule, and they then find that isn't the case? What will they do? Even if they where to act quite sensibly, in *no* way whatsoever could their behaviour be deduced just from the information that the supply and demand curve gives us.

Haavelmo goes on to propose that:

> … the conceptual apparatus of game theory could conceivably be used to construct such a model. But which assumptions should one then make about contacts between sellers and buyers, about their negotiation strategy, about their knowledge of the market, and so on? Here the possibilities are obviously endless. One thing is in any case certain: a vague postulate of 'many buyers and sellers' will not suffice to determine how this game should proceed.

The industrial economics literature has indeed borne out Haavelmo's prophecy that the possibilities are endless. He further comments that for the game to be static and at the same time to "reflect practical possible behaviour" the buyers and sellers would have to find the market price at "their first try." Haavelmo dryly comments that, "Presumably we would find that the buyers and sellers taking part in such a game would have to be some remarkably well informed beings." Haavelmo then goes on to discuss the usual answer to these difficulties: "just make the theory dynamic." Haavelmo responds: "That answer however, seems to come very close to saying that the demand-supply cross is indeed a fine thing; it is just that it cannot answer any of our questions!" Haavelmo points out that when textbooks tell the intuitively very credible story that when prices are too high they will fall and if they are too low they will rise, but as Haavelmo points out, too high or low in this context "are expressions that are given their meaning by reference to the demand-supply cross" – and it was where they would intersect that was the original problem! Haavelmo finishes his small article by discussing the development of the general equilibrium model. In economics after Walras the existence of a meaningful solution has been the focus and that the demonstration "that such solution exists under quite general assumptions is considered one of the greatest triumphs in the area of general equilibrium theory." Haavelmo continues:

> As is well known, that Walrasian general equilibrium model may be assumed to have certain 'optimal' properties according to a definition due to Pareto. Seemingly, all that was lacking was a demonstration that the system actually possessed a feasible solution. Since that has now been put in order, all might seem to be well. But there is a problem with the dynamics when the system is found 'of its equilibrium point'. So far, economic theory has, I think, treated the latter problem with somewhat less respect than it deserves. The system's dynamic motion has been regarded as no more than an appendix to the static model – an appendix of such sort that if only the *static* model has a certain form, prices and quantities will be drawn to the equilibrium point. What has been said above should give reason to be careful in making the claim that the solution of the general equilibrium model shows what will actually happen in a freely competitive market system.

It would be beyond the scope of this article to analyse the efforts that have been done in order to try to show that the general, static equilibrium is in fact a stable equilibrium. The interested reader can consult among other works F. M. Fisher *Disequilibrium Foundations of Equilibrium Economics* from 1983. The main conclusion of that book, written by an author fundamentally positive to the neoclassical paradigm, but with also a strong sense of scientific rigour is worth quoting: "This investigation has come some distance from its origins in the traditional stability literature. Unfortunately, there is still a long way for further research before we have a sound foundation for equilibrium economics." (page 212).[6] In my opinion that is still the case, which means that even on the level of highly abstract theory there is no compelling reason to give the well-known policy recommendations from main stream economics any privileged status.

The role of government – from a theoretical point of view

For the economic elites of society one of the most important "results" of neoclassical theory, is that "the less government, the better." But as soon as one takes into consideration all the endless imperfections, externalities, information asymmetries of real life this "result" has no scientific foundation, only an important ideological role to play. Or as Stiglitz formulates this in the above cited Nobel lecture:

> In the 1980s, there was a strong movement toward privatizing state enterprises, even in areas in which there was a natural monopoly, in which case government ownership would be replaced with government regulation. While it was apparent that there were frequently problems with government ownership, the theories of imperfect information also made it clear that even the best designed regulatory systems would work imperfectly. This raised naturally the question of under what circumstances could we be sure that privatization would enhance economic welfare. As Herbert Simon [1991] the 1978 Nobel Prize winner had earlier emphasized, both public and private sectors face information and incentive problems; *there was no compelling theoretical argument for why large private organizations would solve these incentive problems better.* (Stiglitz 2003, my emphasis)

To sum up: What is called "economic theory" is highly controversial. The theory is based on assumptions that cannot be relaxed while keeping its main results about markets making the optimal allocation of resources and that government have no intrinsic positive role to play. One could of course ask if the lack of scientific foundation for neoclassical policy recommendations have any practical significance. It is beyond the scope of this article to argue this at length on a general, macroeconomic level, but in my opinion the recent transformation in Eastern Europe and the experience of the Nordic countries are relevant in this respect. The experience of Russia shows clearly that although you do everything according to the recommendations of neoclassical economics you might find yourself in a worse situation, not only in the short, but also in the medium term. This is no surprise, given that you do not have a theory of change, of a path from A to B, only a theory of an *unstable* equilibrium point. To do worse than the Soviet Union under Brezhnev and Gorbatchov, is actually making quite an achievement. In the Nordic countries – where for decades before and after WWII one has done most things "against the book," the labour productivity and welfare is unsurpassed. This means that strong unions, compressed wage scale, huge economic transfers[7] are not a brake on economic efficiency. This comes as no surprise as soon as one frames the problem not as static equilibrium, but as an optimal control problem – where government, unions and other civil society has an indispensable role in utilising both the creative and the destructive aspects of capitalist competition.

[6] A newer and less mathematically demanding overview is found in Currie and Steedman (1990).

[7] Seen from a neo-classical point of view. From a social democratic point of view, the enormous incomes of the wealthy are not legitimate, so the taxation actually brings the income distribution more in line with what it should have been according to the real productive effort.

The problem of "initial endowments"

One of the claims of objectivity of the neoclassical school, is that it only discusses what is the most efficient allocation of scare resources. It leaves so to speak the judgement on the initial distribution of wealth and resources for other ethical, moral and philosophical "value systems,", i.e., "subjective" theories to evaluate the initial distribution of wealth. But this neat separation does not hold as soon as one take into consideration the real life links between distribution and efficiency. Feudal tenants produce more than slaves; peasants owning land more than tenants; trusted and valued labour, more than distrusted and oppressed labour. As Stiglitz puts it in discussing the transition in Eastern Europe:

> I stress the results on the link between issues of distribution and issues of efficiency, because some of the recent discussions of reform within Eastern Europe have stressed efficiency concerns, with limited regard to the consequences for distribution. Years from now this lack of concern for distribution, I will argue later, may come to haunt these economies, not just in the form of social unrest, but more narrowly in terms of long-run economic efficiency. *At the very least, there is no intellectual foundation for the separation of efficiency and distributional concerns*. (Stiglitz 1995, page 50, my emphasis)

In regard to Internet governance, the neoclassical economists do not at all discuss the legitimacy – or the efficiency of the initial distribution of wealth, in this particular context – the initial distribution of control over key Internet resources. The Internet was created by researchers with a vision (see the other articles in this issue). Did these researchers create an inefficient infrastructure – or was it one that in many ways was very well suited as a platform for the free flow of information, opening up a space for deliberative, participatory democracy? Was the governance of the Internet in any significant way improved when the U.S. government took the governance out of the hands of the research community and semi-privatized it through the creation of ICANN?

Domain names as "initial endowments"

The question of creation, distribution and governance of domain names is an excellent illustration of the question of initial endowments and the role of government in this area. The fundamental question is of course one of legitimate power. History has seen various forms of legitimate power, both Hellenic slave-owner democracy and absolute monarchy. But after the French revolution the principle that legitimate power resides with the representative assembly elected by all adult inhabitants has become achieved rough consensus. Even dictatorships organise fake elections in order to give themselves legitimacy by this principle. The same goes for the regulation of questions of global importance, to which the governance of Internet clearly belongs. That is why the dominance of the U.S. government is seen as a result of an unplanned historical development, but which cannot be the final solution for Internet governance. But there will always be historical given circumstances that shape the representative process, making it more or less representative.

There are fake elections in dictatorships like China, North Korea, and Iran. Also, there are electoral processes that are grossly unproportional and/or influenced by the resources put into the election campaign by the wealthy that one might question their legitimacy. The U.S. is notoriously known for the influence of money, the parliaments of UK and France for the very un-proportional nature of the electoral process. There are "representative bodies" like the ITU[8] that are less representative of the "users" than IAB and IETF[9] and other informal, NGO-like structures.

The complexities of democracy are the fundamental themes of political science and it is not the focus of this article. The key issue in this context is that neoclassical theory does not see the fundamental difference and potential contradic-

[8] The International Telecommunication Union, originally an organisation of state telecom companies. After deregulation a more fuzzy membership, but the ITU has UN status and is as such a legitimate body.

[9] The Internet Architecture Board and the Internet Engineering Task Force. IAB is a body elected via the Internet. The IETF is a network, a forum for governance of the more technical aspects of the Internet.

tion between the fundamental democratic principle of one man one vote and one dollar one vote. The latter are the dollarocracy of market processes which neoclassical theory holds will maximise welfare. But what happens if elected government disagrees with the "market?" The governance of ccTLDs[10] is an illustrative example.

From the late seventies to the late nineties the distribution of the ccTLDs was in the hands of John Postel and his network.[11] Postel gave them away according to his own judgement. The result was in most cases acceptable. In some cases idealists turned over the country code to the government. In other cases they made a fortune out of them. There are examples like .la for Laos that for some years was not under the control of the Laotian government, but was used in Los Angeles. There are .tv, .cc, .nu and .ws (small island states) that are fully commercial, i.e., the contents of the second level domains have nothing to do with the states or their culture. In Norway for example, to register a second level domain name in the .no top level domain, requires registration in the official business register, which means that only organisations with a presence on Norwegian territory can register. The Government Advisory Committee of ICANN has argued that it has property rights in the country codes when used as second level domain names for example fr.com, fra.com. The point here is not to discuss whether such claims are reasonable, only to point out that neoclassical theory by its anti-government theoretical basis, or more precisely, bias, tends to say that the "market" should solve such issues -, i.e., in most cases favouring the already wealthy and/or powerful.

Is the Internet a public good?

There is general agreement that the use of the information and communication facilities on the Internet is a public good. It fulfils the two conditions of *non-rivalry* in consumption and *non-excludability.* It is of course well known that there are few pure public goods. National defense is an often used example, but it is clear that in a given situation there might be limited forces. Parts of the national territory might be left to the enemy or get less air or ground support because it is inefficient to distribute the forces of national defense. With digitalisation, radio waves can be encrypted to achieve excludability in order to avoid free-riding in pay-TV systems. On the Internet, as in telephony, there are capacity limits, but the cost of increasing capacity is so low, that there are no real shortage and no rivalry in consumption. There is an ample possibility to try to exclude, but no good reason to do so. The conclusion being that from a practical, commonsense point of view, the use of the Internet is as a public good.

Is the domain name system a public good?

To answer this question in the negative and to argue that auctions of domain names would increase the use of Internet resources is the main aim of Mannheim and Solum's article "An Economic Analysis of Domain Name Policy." In their article Mannheim and Solum are so eager to make everything private goods that they also argue that the root server service is a private good. This part of the Mannheim and Solum argumentation is not very convincing. The fact that the infrastructure is costly is of course no argument that the root server service is a private good. Take water in Norway. The infrastructure certainly costs, but costs are covered by taxes.[12] But water is clearly a public good, since it is abundant in Norway. Both non rival and non excludable. The cost of the root server system is marginal to the cost of the Internet as a whole – and we are all benefitting from the fact that others let us use their hardware for free in order to use the information they put out for free.

That domain names are scarce – in contrast to the domain name system – is obvious. Not because there is – as Mannheim and Solum also point out – an "engineering scarcity" – there is more than enough possible letter combinations. Domain names are scares because they carry

[10] Country code Top Level Domains, i.e., like .us, .uk, .fr for U.S., United Kingdom and France.

[11] This is not an accurate account of this process. To my knowledge no systematic history of this process exists.

[12] These taxes could have been lump sum. In most cases they are proportional to number of square meters that the household possesses. This can be seen either as a proxy for consumption or as a kind of progressive tax.

meaning and thus make navigation on the Internet easier. Each domain name can only be allocated to one firm/person. From this fact Mannheim & Solum concludes:

> We think this [auction] system could break the logjams that have characterized the addition of new gTLDs to the root. A paradigm shift is required to make this work. ICANN has to stop treating the name space as a public good – requiring strict regulation in the public interest. Once it recognizes that domain names are private goods, and allows market allocation, a more efficient system of name space management should emerge. (page 408)

From the neoclassical perspective an auction insures that a scarce resource is put to its best use. In my opinion this overlooks the fact that the reason why domain names are valuable is because they are a kind of language and in this respect a common good. The fact that the TLD system we have, and which no one now sees as optimal, shows how important is path dependency, i.e., historical "accident." The .gov, .mil and .edu testifies to this. Why should not .edu be used by all educational institutions world wide and not only U.S.? Or as a common second level domain for such institutions, e.g., edu.us, edu.fr and edu.uk?[13] One has really to be a true believer in the virtues of the market to believe that an auction scheme would give the most rational use of domain names.[14] Who will speak for those with less money – both poor states, diverse ethnic, religious and political communities? That the current procedure of the ICANN is far from optimal is equally true.[15] To charge 50,000 USD as some non refundable proposal processing fees is a really questionable procedure. The criteria that ICANN used choosing seven of the 44 applicants seems far from clear. What is needed is a much larger process, a multi stakeholder process where representative governments, business community and civil society became involved. Basically it is the users of the Internet, the Netizens, that should have a decisive voice here. Ironically, a world wide discussion would be as close as one in reality could come to "perfect information" about the preferences regarding what system of domain names would serve us best. That there would be very different opinions is clear, but it is not given that a rough consensus could not be reached.

The Mannheim and Solum critique of the "taxonomy" alternative

Every auction alternative faces the problem that in contrast to, for example radio frequencies or telephone number series, it is far from given what TLDs should be auctioned. Mannheim and Solum write:

> It is unrealistic to expect ICANN to rationally determine which gTLDs should be added to the root. There are few if any objective selection criteria. Does a gTLD need to be pronounceable or have semantic meaning? Does it need to be descriptive? (page 418)

It is strange to pose the question, do domain names need to have semantic meaning. That is precisely why they are useful, why they become scarce and acquire economic value. A bit further down on the same page they conclude:

> In fact, there may be no rational policy choices. Regulatory decisions on which gTLDs to add are inevitably arbitrary, or simply favour particular interest groups. The highly engineered grid of gTLD assignments that mark the current domain name space does not necessarily measure or meet the needs of the Internet community. (page 418)

As indicated above, and as I will discuss in more detail further down, there is a rational choice: to call upon the Internet users, some of them in their capacity as experts in fields like

[13] Actually in the UK ac for academic is often used.

[14] Stiglitz in his book, *Wither Socialism?* has an interesting approach in this respect. Since the model of market socialism shares the fundamental belief in perfect markets as the neo-classical paradigm – all the reasons why market socialism did not work are at the same time arguments why capitalist markets do not work the way the neo-classical model predicts. To understand how markets really work one most turn to the heterodox, dynamic schools of economic modelling.

[15] Mannheim and Solum hold that "… ICANN's current staffing plan is arguably inadequate. For example it does not have a professional economist on staff – a dangerous condition for an entity responsible for making economic decisions with potentially enormous consequences." One is tempted to propose *two* economists, one orthodox and one heterodox in order to also get another view of market dynamics, relationship between market and democracy, etc.

linguistics, information theory, communication etc. It is illusory to think that domain names are neutral; they will of course be socially constructed. It is a good thing that they “favour” special interest groups, society consists of special interest groups. The question is only which interest group(s) get the upper hand when the domain name system is designed. Like many others when they discuss Internet governance Mannheim and Solum speaks with contempt about “political pressures.” Again, to be useful the Internet should suit some political interest. Neither researchers nor “markets” are politically neutral. In various contexts they do more or less express the interests of consumers or a majority/minority of the economic and political elites. It should come as no surprise that ICANN with its “baroque structure,” its promarket and anti-government ethos is a creation not well suited to create a rational domain name system.

The current root, which has worked rather well, was intended to be taxonomized. The ccTLDs are the standardised ISO codes for states. The gTLDs were intended to designate various categories of information providers. The famous .com was for commercial enterprises, .org was for nonprofit enterprises, .net for internet related information providers, etc. What is really the problem is as Mannheim and Solum quite precisely point out: “… the taxonomy paradigm has already been violated by the opening of restricted TLDs (such as .org, .net, and even ccTLDs such as .tv and .us) to general commercial use. But given the existing Internet, guessability does not prove that a taxonomy is better than auctions. […] The guessability argument fails, first and foremost, because second and third level domains are not taxonomized.” (page 439)

But why has it been violated? Is that not precisely because one has bowed before market forces, has not installed a regime that would create a rational information system? Mannheim and Solum do not seem to have any qualms about the misuse of the .tv, i.e., the ccTLDs of micro states. But the DOC and ICANN have the power, not only to protect trademark and brand names, but also to discipline those registrars that misuse the intended meaning of domain names. The same goes for second and third level domain names. We are back to the lack of a democratic, Netizen-inspired process of creating a DNS.

No wonder Mannheim and Solum do not like the taxonomy alternative. The only vision they have is that, “a taxonomy committee … [which] would consist of a small number of individuals, likely volunteers, likely without a substantial staff, who would work part-time on the project of developing the taxonomy.” (page 438). They are equally skeptical of ICANN in this respect:

> If ICANN did decide to expand the root by creating an expanded taxonomy, that decision would be made by the bottom-up, consensus driven ICANN process. But that process is not well suited as a method for determining the highest and best uses of the root. Participants in the ICANN process are, for the most part, technical specialists and not entrepreneurs. (page 439)

To Mannheim and Solum, even after Enron and the dotcom crash – it is entrepreneurs that really are capable of creating the best of all possible worlds. That “technical specialists,” guided by a vision, created the Internet is of course of virtually no importance in this context.

Reform ICANN or create new navigation tools by semantic web?

This is yet another big issue beyond the scope of this article, but in my opinion ICANN is beyond reform. And in any case, domain names are a very information poor structure, better than nothing of course, but using domain names for navigation belongs to the past. Netizens of Cyberspace should unite, ally themselves with firms and governments and UN-organisations that go for an open process of semantification. This will reduce the importance and consequently the commercial value of domain names. Still of course “controlling the root will be important” because the threat to throw out those that do not behave according to the rules lays in the hands of those controlling the root. But the navigation aspect of domain names will change. But most importantly – once more noncommercial (but not anti-commercial) mechanism can improve the use of this very important public good that the Internet has been, is and will be in the foreseeable future. In short, the new and vaguely outlined

Internet Governance Forum should focus on the semantic web in order to "create facts on the ground," in order to mobilize the Netizens and progressive parts of the private sector. The private sector is better served by a new and vastly more powerful semantic web[16] than an enlarged set of gTLDs. What is the use of having both .com and .biz beside having to do defensive acquisitions in both domains?

Do we need competing Internets?

I raise this really bizarre question only to show how "far out" this belief in neoclassical vision of perfect competition can lead us. When you believe that competition is the answer to most social and economic challenges, then why have one Internet – why not have competing root server systems? Or as it was stated in the "Green Paper" that laid the foundation for the privatisation of the DNS:

> Where possible, market mechanisms that support competition and consumer choice should drive the management of the Internet because they will lower costs, promote innovation, encourage diversity, and enhance user choice and satisfaction.

In a working paper from the International Centre for Economic Research, Gordon L. Brady argues enthusiastically for competing Internets:

> Let us hope that the alternative Internets will arise without unnecessary restrictions andmake the sluggish (and highly political) regulation by ICANN less important.

The background for Brady's wish for alternative Internets are real. Brady points out that:

> ICANN rejected 'dot-travel,' proposed by the International Association of Travel Agents (IATA), which represents more than 70% of all travel agents on the grounds that IATA was not representative of the industry. ICANN also decided to add 'dotbiz' as a TLD while refusing to recognize that the owners of the pre-existing 'dotbiz' registration on a competing root server system might have a prior claim to that name on the A-root server. This suggests that ICANN may block efforts to broaden competition within cyberspace.

Although they in principle agree on the desirability of competition for root service, Mannheim and Solum are for once realistic enough to realize that root service is a natural monopoly. They correctly outline the scale, scope and network effects that create a monopoly.[17] Consequently they pose the real question:

> What is surprising is that any alternative root service providers exist at all. What explains the emergence of these failed attempts to compete with ICANN? The most obvious explanation is ICANN's restriction on the TLD space. (page 364)

Brady goes into the technical details on how to use alternative root servers. The simple fact that to have to use different Internets, with different – and competing DNS – would be a big step backwards is completely overshadowed by the fascination of the wonders of competition.[18] That Brady cares more for IATA and the owners of the alternative .biz than for the millions of knowledge and information users of the Internet just makes the picture complete.

The costs of competition and auctions

Mannheim and Solum, like most other neoclassical economists underestimate the costs of competition – like for example the PR-wars between producers when their products basically are in reality homogenous, i.e., identical as the neoclassical model requires (shampoo, cars, soft-drinks, etc., etc.) and irrational product differentiation is a question of life and death. In this con-

[16] Their devotion to an auction solution lead Mannheim and Solum to be unenthusiastic about a new real semantic onthology based Internet. They write: "But we do not need to taxonomize the root in order to add 'Yet Another Hierarchically Organized Outline' to those that already exist. Such taxonomized schemes of Internet access are provided by YAHOO, Google, Lycos, and dozens of other services." (page 439). But these services are based on indexing of free-text, only ad-hoc, post-fact classification is involved – and consequently they often give thousands of irrelevant hits even when searching for well identified information.

[17] That "increasing returns to scale" are pervasive, that to create them is a major way of competing – and that they completely destroy the solution of a general equilibrium model seem not to worry Mannheim and Solum.

[18] That in real life – utterly imperfect – competition is the driving force of growth, see Baumol (2003).

text it is far from clear that more general TLDs would do any good. Most big firms and most governments would have to buy their brand name as a SLD in any TLD in order to block others from misusing it. More TLDs would only benefit those who live off selling registration and register services. Mannheim and Solum's solution to this problem is to argue that every big firm could have its own TLD,[19] probably through yet another costly auction process. But if one from the start had a Netizen perspective on domain names both cyber squatting and the cure, the UDRP, could have been mostly avoided. It would have been rational to give www.ibm.com to IBM, since that is part of a rational way to find the web-pages of IBM. As Mannheim and Solum point out there will be windfall gains. The challenge for the economics profession would be to create a theory, taking into consideration the history and dynamics of the relevant markets, where most of these gains end up in the public sector and used for transferring wealth to those whose legitimate needs are not backed by enough purchasing power.

Conclusion

The aim of this article has been threefold. First of all to argue that there is not economic theory in the singular, that there are fundamentally different approaches to the mainstream neoclassical paradigm. Secondly I argue that the neoclassical paradigm has a weak scientific foundation. It is inherently static and cannot handle dynamic processes well. The reason why it dominates is that its policy recommendations in general favour the economic elites and not trade unions and developing countries. Thirdly I argue that in the discussion of ICANN and the Internet domain name system, belief in markets makes them overlook that domain names work because they are a kind of language, and that markets/auctions are not better suited to create a rational system than a world wide democratic process regarding the domain name system. Given the impasse around ICANN the most realistic way to ensure that navigation on the Internet is done in a rational way is to have a democratic process connected to the "semantification" of the Internet, i.e., the next generation Internet. From a Netizen point of view, it is to avoid the Scylla of naïve market idealisation and the Carybdis of ICANN's lobby prone procedures. The task is to create an open, transparent multistakeholder process of Internet governance. The Geneva and Tunis WSIS were small steps in the right direction.

[19] They use the example of .att for AT&T

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